PHPP

BRIEF INSTRUCTIONS

For use in EuroPHit, c

Place your mouse here to see the PHPP help.

If no help appears when the mouse passes over cell B4, you can activate it by going into the Menu Bar Tools/Options/View, and under "Comments", select "Comment Indicator Only".

Passive House Verification: Meaning of Field Formats

Example	Field Format	Meaning
78,8	Courier New, blue, bold on yellow background	Input Field: Please enter the required value here
01ud tripple-low-e-cr08	Arial Narrow, blue, bold on brown	Data entry field with drop down list
6619	Arial, black, standard on white background	Calculation field; please do not change
78,8	Courier New, purple, bold on white background	Field with references to another sheet - should not be changed.
126,0	Arial, black, large & bold on green background	**Important result**

Passive House Planning: Worksheet Directory

Worksheet name (to show/hide worksheets please use the separate 'Profile settings' tool)	Function	Brief Description	Required for the certification?
Verification	Building data; summary of results	Building description, selection of the calculation method, summary of results	yes
Overview	Overview of the specific data of the project entered	In-depth project description, overview of all results and input variables, specific details on building envelope, building services systems as well as general information.	no
Variants	Variant calculation	Input parameters and results for the variant calculations. Predefined fields for frequent entries, as well as user-defined area.	no
Comparison	Comparison between two variants	Comparison between two variants under the energy demand and economic viability perspective. Input of comparison configurations.	no
Climate	Climate Region Selection or Definition of User Data	Climate data for: Annual Heating, Windows, Heating Load, Heating, Summer, Cooling, Cooling Units, Cooling Load worksheets	yes
U-Values	Calculation of Standard building assembly U-Values	Heat transmission coefficient calculations in accordance with DIN EN ISO 6946.	yes
Areas	Areas summary	Building assembly Areas, Thermal Bridges, Treated Floor Area. Use exterior dimension references!	yes
Ground	Calculation of reduction factors against ground	More precise calculation of heat losses through the ground	if applicable
Components	Building component database	Database of certified, Passive House suitable components and entry of user-defined components	yes
Windows	U_W-Value Determination	Input of geometry, orientation, frame lengths, frame widths, U_g and U-values of the frame, and the thermal bridge heat loss coefficients of the connections; from these inputs, determine U_W and total radiation.	yes
Shading	Determination of shading coefficients	Input of shading parameters, e.g. balcony, neighbouring building, window reveal and calculating the shading factors	yes
Ventilation	Air Flow Rates, Exhaust/Supply Air Balancing, Pressurization Test Results	Sizing the ventilation system from extract and supply air requirements, infiltration air change rate and actual efficiency of heat recovery, input of pressurization test results	yes
Additional Vent	Design and planning of ventilation systems with diverse ventilation units	Extension of the Ventilation worksheet for dimensioning air flows, for special building uses and systems with various ventilation units	if used
Annual heating	Annual heating demand / Annual Method	Calculation of the annual space heating demand according to the energy balance method following EN 13790: Transmission + Ventilation - h (Solar Gains + Internal Gains)	no
Heating	Space heating demand calculation Monthly method according to EN 13790	Calculation procedure for the monthly method following EN 13790. Make appropriate selection in the Verification worksheet, if calculations should be performed following this procedure	yes
Heating Load	Building Heating Load Calculation	Calculation of the nominal heating load using a balance procedure for the design day: max transmission + max ventilation - η (minimum solar gains + internal heat gains)	yes
SummVent	Determination of Summer Ventilation	Ventilation in cooling case and estimation of air flow rates for natural ventilation during the summer period	yes
Summer	Assessment of Summer Climate	Calculation of the frequency of overheating as a measure of summer comfort	yes
Cooling	Monthly Method for Cooling Demand	Annual useful cooling demand calculation	if present
Cooling units	Latent Cooling Energy	Calculation of the energy demand for dehumidification and choice of cooling method	if present
Cooling load	Building Cooling Load Calculation	Calculation of the daily average cooling load of the building	no
DHW+Distribution	Distribution losses; DHW Requirement and Losses	Heat loss calculation of the distribution systems (heating; DHW); calculation of the useful heat requirement of DHW and storage losses	yes
SolarDHW	Solar DHW Heating	Solar contribution calculation for DHW and space heating contribution	if solar panels are used
PV	Electricity generation by photovoltaic	Electricity generation calculation of PV system	no
Electricity	Electricity Demand for Dwellings	Calculation of the electricity demand of Passive Houses with residential use	yes
Use non-res	Patterns of non-residential Utilisation	Input or selection of utilisation patterns for planning of electricity demand and internal heat gains	no
Electricity non-res	Electricity Demand for non-residential Use	Calculation of the electricity demand for lighting, electric devices and kitchens for non-residential buildings	no
Aux Electricity	Auxiliary Electricity Demand	Calculation of auxiliary electricity and corresponding primary energy demand	yes
IHG	Internal Heat Gains in Dwellings	Calculation of the internal heat gains based on the Electricity and Aux Electricity sheets.	no
IHG non-res	Internal Heat Gains for non-residential Use	Calculation of the internal heat gains for non-residential buildings based on the Electricity non-res worksheet and the occupancy	no
PE-Value	Specific Primary Energy and CO_2 Demands	Selection of heat generators, calculation of the specific primary energy and CO2 demands from the present results	yes
Compact	Efficiency of Heat Generator Compact Heat Pump Unit	Calculation of combined heat generation efficiency for heating and DHW only by means of a electric heat pump compact unit, considering the specific project boundary conditions.	if present
HP	Heat generation efficiency of the heat pump	Calculation of heat generation efficiency for one to two electric-run heat pumps, considering the specific project boundary conditions.	if present
HP Ground	Ground probe or ground collector in combination with a heat pump	Heat source calculation for a ground probe or horizontal subsoil heat exchanger for ground-coupled heat pumps, considering the specific project boundary conditions.	if present
Boiler	Efficiency of Heat Generator Boiler	For the calculation of the efficiency of heat generation with standard boilers (NT and calorific boilers) for the project given boundary conditions.	if present
District Heating	District Heat Transfer Station	Calculation of the final and primary energy demands (heat)	if present
Data	Database	Table of primary energy factors following [GEMIS] and database of EnEV (German energy efficiency regulation).	no

EnerPHit verification

Building:	Primary School 8 "Sveti Sveti Kiril I M		
Street:	69 Mogilov blv.		
Postcode/City:	Gabrovo		
Country:	Bulgaria		
Building type:	School		
Climate:	Велико Търнов		
Altitude of building site (in [m] above sea level):	426		
Home owner/client:	Municipality of Gabrovo		
Street:	3 Vazrazhdane square		
Postcode/City:	Gabrovo		
Architecture:		Mechanical System:	
Street:		Street:	
Postcode/City:		Postcode/City:	
Energy consulting:		Certification:	
Street:		Street:	
Postcode/City:		Postcode/City:	

Year of Construction:	2014	Interior temperature winter [C°]	18,0	Interior temp. summer [C°]	24,0
Number of dwelling units:	1	Internal heat gains winter [W/m²]	5,4	IHG summer [W/m²]	5,4
Number of Occupants:	60,0			Spec. capacity [Wh/K per m² TFA]	204
Exterior vol. V_e:	4180,4 m³			Mechanical cooling:	

Specific building demands with reference to the treated floor area

				Requirements	Fulfilled?*
	Treated floor area	719,4	m²		
Space heating	Annual heating demand	**55**	**kWh/(m²a)**	25 kWh/(m²a)	**no**
	Heating load	**44**	**W/m²**	-	**-**
Space cooling	Overall specific space cooling demand		**kWh/(m²a)**	-	**-**
	Cooling load		**W/m²**	-	**-**
	Frequency of overheating (> 24 °C)	7,8	%	-	**-**
Primary Energy	Heating, cooling, dehumidifying, DHW, auxiliary electricity, lighting, elect.	**171**	**kWh/(m²a)**	168 kWh/(m²a)	**no**
	DHW, space heating and auxiliary electricity	143	kWh/(m²a)	-	**-**
	Specific primary energy reduction through solar electricity		kWh/(m²a)	-	**-**
Airtightness	Pressurization test result n_{50}	**2,0**	**1/h**	1 1/h	**no**

* empty field: data missing; '-': no requirement

EnerPHit building retrofit (acc. to heating demand)? **no**

I confirm that the values given herein have been determined following the PHPP methodology and were determined based on the characteristics of the building.
The PHPP calculations are attached to this application.

Name:	Company:	Registration number PHPP:
Surname:	Issued on:	
		Signature

EnerPHit planning:

PROJECT OVERVIEW

Basic data

Building, name of the object	Primary School 8 "Sveti Sveti Kiril I Metodi" -		
Street:	69 Mogilov blv.		
Postcode/City:	Gabrovo		
Country:	Bulgaria		
Building type:			
Climate: region / climate data set	User Data		User data - Вел
Climate: degree days / altitude	77	kKh/a	426
Building type / building status	School | University		
Context of urban development	Urban development		
Building type / construction	EnerPHit building retrofit (acc. to heating demand)		
Building category, in terms of energy	EnerPHit-i		
Year of construction / year of construction of existing building	2014		1970,0
Amount of dwelling units for residential use / non-residential use		Dwelling units	7
Number of occupants standard / planned		P	60
Standard / design occupancy rate		m²/P	12
Home owner / client	Municipality of Gabrovo		
Architect			
Building services			
PHPP/Energy balance			
Building physics			
Structural engineering			
Contractor / tradesperson / other (max. 5000 characters)			
Interior temperatures winter/summer	18	°C	24
IHG winter / summer	5,43	W/m²	5,43
Type of certification	EnerPHit building retrofit (acc. to heating dem		
Project certification / Certificate ID			
Certification body			
PHPP-version / PHPP-registration number	Version 9.0 beta		

Characteristic value according to EnerPHit verification

Treated floor area A_{TFA} / exterior volume V_e	719,39	m²	4180,4
	Specific Demand		Requirement
Space heating demand	55	kWh/(m²a)	25
Heating load residential		kWh/(m²a)	-
Heating load Non-residential	44	kWh/(m²a)	-
Frequency of overheating	8	%	Recommendation: < 10%
Overall specific space cooling demand		kWh/(m²a)	-
Cooling load residential		kWh/(m²a)	-
Cooling load non-residential	44	kWh/(m²a)	-
Airtightness pressure air exchange rate test n_{50}	2,0	1/h	1
Total PE Value	171	kWh/(m²a)	168
Heating, cooling, DHW, auxiliary electricity, lighting, electrical appliances			
Specific PE Demand - Mechanical System / CO_2-Equivalent	143	kWh/(m²a)	34
Heating, DHW, auxiliary electricity (no lighting and electrical appliances)			
Solar power: Primary energy savings / CO2 emissions		kWh/(m²a)	

Average building quality

	Specific Demand		Requirement
Average U-value of external insulation to outside air	0,13	W/(m²K)	-
Average U-value of external insulation to ground		W/(m²K)	-
Average U-value interior insulation to outside air		W/(m²K)	-
Average U-value interior insulation to ground	0,29	W/(m²K)	-
Average U-value of thermal bridges ΔU	0,01	W/(m²K)	-
Average U-value windows	2,75	W/(m²K)	-
Average U-value of exterior doors	2,25	W/(m²K)	-
Ventilation system eff. heat recovery efficiency	81,07	%	-

Building envelope and site

Building envelope area A_{total} / treated floor area A_{TFA}	1785	m²	719
A/V-ratio / Envelope area use (A_{total}/A_{TFA})	0,43		2,48
Window area / Window area percentage	228	m²	12,8%
Specific solar aperture / Passive solar heating mode	2,4%		11407
Building site area / built-up area		m²	
Gross floor area BGF / Gross external volume BRI		m²	
Floor space ratio / Amount of complete storeys			

Building description (max.5000 characters)

Opaque building components

Exterior wall: U-value (average value) / area	0,14	W/(m²K)	518,51
Standard exterior wall: U-value / thickness		W/(m²K)	0,0
Standard exterior wall: total area / area fraction		W/(m²K)	
Standard exterior wall: name / certified?			
Standard exterior wall: short description (materials, manufacturer, product name, special features)			
Exterior wall against ground: U-value (average value) / area	0,27	W/(m²K)	235,86
Standard exterior wall against ground: U-value / thickness		W/(m²K)	0,0
Standard exterior wall against ground: area / area fraction		W/(m²K)	
Standard exterior wall against ground: name / certified?			
Standard exterior wall against ground: short description (materials, manufacturer, product name, special features)			
Roof / top floor ceiling: U-value (average value) / area	0,11	W/(m²K)	400,34
Standard roof / top floor ceiling: U-value / thickness		W/(m²K)	0,0
Standard roof / top floor ceiling: area / area percentage		W/(m²K)	
Standard roof / top floor ceiling: name / certified?			
Standard roof / top floor ceiling: short description (materials, manufacturer, product name, special features)			

Floor slab / basement ceiling: U-value (average value) / area	0,30	W/(m²K)	400,34
Standard floor slab / basement ceiling: U-value / thickness		W/(m²K)	0,0
Floor slab / basement ceiling standard: area / area fraction		W/(m²K)	
Standard floor slab / basement ceiling: name / certified?			
Standard floor slab / basement ceiling: short description (materials, manufacturer, product name, special features)			
Thermal bridges: Y-value (Average value) / length	0,057	W/(mK)	223,70
Thermal bridge free limit value / Complied?	0,01	W/(mK)	no
Thermal bridges: short description (max.5000 letters) (additional notices, manufacturer, product name, materials, others)			

Windows / doors / shading systems

windows/facades: U-value (average value) / area	2,75	W/(m²K)	227,81
window/facade frames: U-value (average value) / area	2,32	W/(m²K)	111,22
Glazing: U-value (Average value) / areas	2,70	W/(m²K)	116,59
Ψ-Value Glazing edge (average) / Ψ-Value Installation (average)	0,040	W/(mK)	0,040
Standard window frame: U-value / frame width		W/(m²K)	
Standard window frame: window area / area percentage		W/(m²K)	
Standard window frame: glass edge Ψ-value / installation Ψ-value		W/(mK)	
Standard window frame: name, certified?			
Standard window frame: Short description (materials, manufacturer, product name, installation)			
Standard curtain wall facade: U-value / Frame width		W/(m²K)	
Standard curtain wall facade: Facade area / Total area percentage		W/(m²K)	
Standard curtain wall facade:Ψ-value glazing edge / Ψ-value installation		W/(mK)	
Standard curtain wall facade: Description / Certified?			
Standard curtain wall facade: short description (materials, manufacturer, product name, installation)			
Standard glazing: U-value / g-value		W/(m²K)	
Standard glazing: Facade area / Area ratio		W/(m²K)	
Standard glazing: Description / Certified?			
Standard glazing: short description (description, manufacturer, product name, installation)			
Standard glazing 2: U-value / g-value		W/(m²K)	
Standard glazing 2: Facade area / Area percentage		W/(m²K)	
Standard glazing 2: Description / Certified?			
Standard glazing 2: short description (description, manufacturer, product name, installation)			
Roof lights / light domes: U-value / frame width		W/(m²K)	
Roof lights / light domes: window area / area section		W/(m²K)	
Roof lights / light domes: glazing U-value / g-value		W/(m²K)	
Roof lights / light domes: Y-value glass edge / Installation Y-value		W/(mK)	
Roof lights / light domes: name / certified?			
Roof lights / light domes: short description (materials, manufacturer, product name, installation situation)			
Exterior door: U-value (average value) / Area	2,25	W/(m²K)	2,53
Standard exterior door: door U-value / door U-value installed		W/(m²K)	
Standard exterior door: frame U-value / door leaf U-value		W/(m²K)	
Standard exterior door: door leaf thickness / frame width		mm	
Standard exterior door: panel border Y-value / installation Y-value		W/(mK)	
Standard exterior door: Name / certified?			
Standard exterior door: Short description (materials, manufacturer, product name, installation situation)			
Temporary sun protection: Type / Add. Reduction factor		W/(m²K)	8,70
Temporary sun protection: Area / Area ratio		W/(m²K)	

Shading reduction factors: orientation	Reduction factor winter		Summer reduction factor
North	100	%	100
East	78	%	55
South	13	%	28
West	51	%	28
Horizontal	100	%	100

Ventilation

Ventilation: Type of ventilation	Balanced PH-Ventilation with HR		
Calculated supply air demand / supply air per person	3600	m³/h	60
Calculated extract air demand / Amount extract air rooms	0	m³/h	
Design air flow rate (maximum) / Average value reference to maximum	6600	m³/h	50
Average flow rate / Average air exchange		m³/h	
Airtightness test pressure at n_{50} / Air permeability q_{50}	2,00	1/h	3,85
Net air flow for pressurization test / Infiltration flow $n_{V,Rest}$	3439	m³	0,27
Ventilation unit: Description / Certified?			
Ventilation system: effective heat recovery efficiency / electrical efficiency	0,84	%	0,42
Ventilation system: Description (type of heat recovery, manufacturer, product name)			
Ventilation system: installation site / Temperature of mechanical services room	Inside the thermal envelope		20
Nominal width exterior or supply air / exhaust or extract air ducts	60	mm	60
Conductance ambient- or supply air duct / exhaust- or extract air duct		W/(mK)	
Length ambient- or supply air duct / exhaust- or extract air duct	2,00	m	2,00
SHX: efficiency / effective heat recovery efficiency		%	0,00
HE defrosting / Defrosting at a minimum temperature of	yes		4,00
Effective energy recovery efficiency ventilation / Humidity recovery		%	0,0
Ventilation system: Short description (installation site, ducts, silencers, others)			

Summer ventilation

Summer base ventilation: ventilation type		
Air exchange via ventilation system with supply air:	Without heat recovery	1,30
Air exchange via extract air system		1,30
Window ventilation air exchange		0,09
Night summer ventilation: Type of ventilation		
Night air exchange Window Night Ventilation, Manual		0,00
Night air exchange mechanical, automatically Controlled ventilation	Humidity differenceregulated	1,30
Summer ventilation: short description (window opening profiles, night ventilation concepts, others)		

Cooling

Max. indoor absolute humidity / Internal humidity sources	12,0	g/kg	2,0
Frequency of overheating / Overtemperature limit:	7,8	%	24,0
Mechanical cooling: Applied cooling units			
		kW	
		kW	
	0,0		
		kWh/(m²a)	
Mechanical cooling: Average annual coefficient of performance / Electricity demand			0,0
Mechanical cooling: Short description (unit, manufacturer, product name, installation site, installation)			

Heating and DHW				
DHW Demand	18,53	kWh/(m²a)	13329	
Annual heating demand	54,68	kWh/(m²a)	39339	
Direct electricity: contribution to space heating / domestic hot water		%		
PE value energy carrier / CO_2-emission factor		kWh/kWh		
Direct electric heating / domestic hot water				
Final energy demand		kWh/(m²a)		
Direct electricity: short description (description, manufacturer, product name)				
Heat pump: covered fraction of space heating / domestic hot water		%		
PE value energy carrier / CO_2-emission factor		kWh/kWh		
COP heat pump for heating / heat pump for DHW				
Final energy demand		kWh/(m²a)		
Compact unit: Short description (description, manufacturer, product name)				
Compact unit: covered fraction of space heating / domestic hot water		%		
PE value energy carrier / CO_2-emission factor		kWh/kWh		
COP heat pump for heating / heat pump for DHW				
Final energy demand		kWh/(m²a)		
Compact unit: Short description (description, manufacturer, product name)				
Boiler: covered fraction of space heating / domestic hot water	100	%	100	
PE value energy carrier / CO_2-emission factor	1,1	kWh/kWh	250	
Heat generator: building type / COP	Low Temperature Boi-ler Gas		111	
Final energy demand	81,1	kWh/(m²a)		
Boiler: short description (description, manufacturer, product name)				
District heating: Covered fraction of space heating / domestic hot water		%		
PE value energy carrier / CO_2-emission factor		kWh/kWh		
Heat source / Performance of heat generator				
Final energy demand		kWh/(m²a)		
Compact unit: Short description (description, manufacturer, product name)				

Solarthermics			
Collector	Improved flat plate PK SL AL		
Collector area / Specific collector area	0,00	m²	0,00
Deviation from north / Angle of inclination from the horizontal	180	°	45
Solarthermics: Short description (description, manufacturer, product name, installation location)			
Solar contribution to DHW	0,00	kWh/(m²a)	0
Solar contribution to space heating	0,00	kWh/(m²a)	0
Solar contribution total	0,00	kWh/(m²a)	0
Solar Storage	Simple storage 800 l		

PHOTOVOLTAIC			
Module technology	Amorph-Si		
Nominal current / Nominal voltage		A	
Nominal power / Number of modules	0,00	Wp	
Deviation from north / Angle of inclination from the horizontal		°	
Solarthermics: Short description (description, manufacturer, product name, installation location)			
Annual yield of PV modules		kWh/(m²a)	

Aux. electricity / Household electricity

Aux Electricity			
Ventilation units / Electricity demand			13537
Heating system Devices / Electricity demand			1063
DHW-system units / Electricity demand			365
Aux. Electricity solar devices / electr. demand			
Total aux. Electricity	**20,80**	kWh/(m²a)	**14964,96**
Household electricity			
Dishwasher / useful energy demand			4290
Washing machine units / Energy demand			3762
Clothes dryer unit / Energy demand			10474
Refrigerator, Freezer or combination unit / Useful energy demand			574
Cooking unit / energy demand			7500
Lighting			10440
Consumer Electronics			2640
Small appliances, etc.			3000
Other			
Total household electricity	**59,33**	kWh/(m²a)	**42679,53**

Economic data

Total gross construction costs / contained VAT		€	
Building costs (cost group 300+400) / (cost group 200-700)		€	
Total gross construction costs per m² BGF / per m³ BRI		€/m²	
Explanation building costs			
Fostering (Passivhaus, refurbishment, etc.)			
Explanation fostering			

Other

Ecological aspects: rainwater utilization, etc.	
Material used: Regional products / Natural products	
Special features: first project in the country / first project used as	
Building awards	
Research project / funded project	
Description of research / funded project	
Other	

Section

ико Търнов

m

Dwelling units

P

m²/P

°C

W/m²

and)

m³

W/(m²K)

W/m²

W/m²

> 24 °C

W/(m²K)

W/m²

W/m²

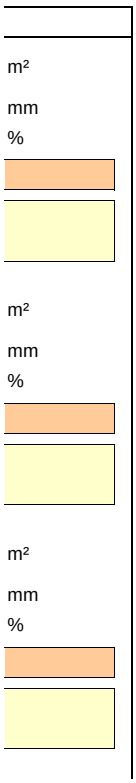
1/h

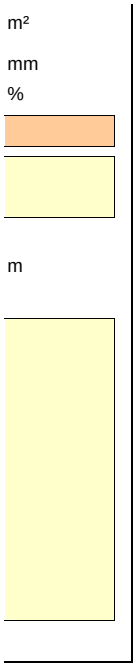
W/(m²K)

kg/(m²a)

kg/(m²a)

	W/(m²K)
	W/(m²K)
	W/(m²K)
	W/(m²K)
	W/(m²K)
	W/(m²K)
	W/(m²K)
	%
	m²
	kWh/a
	m²
	m³
	floors


m²
mm
%
m²
mm
%
m²
mm
%


m²
mm
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m²
W/(mK)
mm
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W/(mK)
mm
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W/(mK)
%
%
mm
%
W/(mK)
m²
m²
W/(m²K)
mm
W/(mK)
m²
%
%
%
%
%
%

m³/(P*h)
pcs
%
1/h
1/h
1/h
Wh/m³
°C
mm
W/(mK)
mm
%
°C
%
1/h
1/h
1/h
1/h
1/h
g/(m²h)
0
m³/h
kWh/(m²a)
kWh/(m²a)

kWh/a
kWh/a

%

g/kWh

%

g/kWh

%

g/kWh

%

g/kWh
%

%

g/kWh
%

m²/P
°

%
%
%

V
pcs
°

kWh

kWh/a
kWh/a
kWh/a
kWh/a
kWh/a

kWh/a
kWh/a
kWh/a
kWh/a
kWh/a
kWh/a
kWh/a
kWh/a
kWh/a

%
€
€/m³

EnerPHit planning:

select active variants
>>

Results	Units
Annual heating demand	kwh/(m²a)
Heating Load	W/m²
Overall specific space cooling demand	kwh/(m²a)
Cooling load	W/m²
Frequency of overheating	%
Total primary energy demand	kwh/(m²a)
Certifiable as EnerPHit building retrofit (acc. to heating demand)?	yes / no
<< **User defined**	**Units**

Input variables	Units

<< Assembly layers ('U-value')

<< Radiation balance ('Areas')

<< Thermal bridges ('Areas')

<< Glazing and frames ('Window', 'Shading')

<< Ventilation ('Ventilation', 'SummVent')

<< Heat generator ('PE-value')

Direct electricity	Fraction of annual heating demand
	Fraction of domestic warm water
Heat pump	Selection HP
	Fraction of annual heating demand
	Fraction of domestic warm water
Passive House compact unit with supply air ventilation pump	Selection of device
	Fraction of annual heating demand
	Fraction of domestic warm water
Boiler (gas, oil & wood)	Selection of boiler
	Fraction of annual heating demand

	Fraction of domestic warm water
District Heating	Selection of heat source
	Fraction of annual heating demand
	Fraction of domestic warm water
Other	Efficiency
	Fraction of annual heating demand
	Fraction of domestic warm water

<< Compressor cooling unit ('Cooling units')

<< User defined

	Description	Units
1	Description	Units
2	Mechanical cooling	x
3	Light Transmission Glazing	-
4	Defroster HX	0/1
5	Solar Collector Area	m2
6	Insulation Thickness:	mm
7	Thermal Conductivity	W/mK
8	Gym hall lightings	W/m2
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
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99		
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CALCULATION OF VARIANTS

Active

4-Step 3(interior wall insulation)	No measures	Step 1 (roof insulation)	Step 2 (wall insulation, Ventilation and heatung system)	Step 3(interior wall insulation)
4	1	2	3	4
54,7	228,4	153,8	76,0	54,7
43,9	123,0	85,2	49,2	43,9
7,8	9,8	3,3	3,5	7,8
171,5	411,8	322,7	194,3	171,5
no	no	no	no	no
Link	Link	Link	Link	Link

Value	1	2	3	4
0%	0%	0%	0%	0%
0%	100%	100%	0%	0%
None	None	None	None	None
0%	0%	0%	0%	0%
0%	0%	0%	0%	0%
0%	0%	0%	0%	0%
0%	0%	0%	0%	0%
Low Temperature Boi-ler Gas	Low Temperature Boi-ler Gas	Low Temperature Boi-ler Gas	Low Temperature Boi-ler Gas	Low Temperature Boi-ler Gas
100%	100%	100%	100%	100%

100%	0%	0%	100%	100%
None	None	None	None	None
0%	0%	0%	0%	0%
0%	0%	0%	0%	0%
0%	0%	0%	0%	0%
0%	0%	0%	0%	0%
0%	0%	0%	0%	0%
0,780	0,78	0,78	0,78	0,78
1,000	0	0	1	1
0,000	0	0	0	0
60,000	60	60	60	60
0,040	0,047	0,047	0,04	0,04
5,700	28,6	28,6	5,7	5,7

Step 5 (windows in 20 years), DHW solar panels				
5	6	7	8	9
18,5				
22,1				
7,3				
116,2				
yes				
Link	Link	Link	Link	

5	6	7	8	9
0%	0%	0%	0%	0%
0%	0%	0%	0%	0%
None	None	None	None	None
0%	0%	0%	0%	0%
0%	0%	0%	0%	0%
0%	0%	0%	0%	0%
0%	0%	0%	0%	0%
Low Temperature Boi-ler Gas	None	None	None	None
100%	0%	0%	0%	0%

100%	0%	0%	0%	0%

None	None	None	None	None
0%	0%	0%	0%	0%
0%	0%	0%	0%	0%

0%	0%	0%	0%	0%
0%	0%	0%	0%	0%
0%	0%	0%	0%	0%

0,69				
1				
17,84				
60				
0,04				
5,7				

10
10

0%
0%
None
0%
0%
0%
0%
None
0%

0%

None
0%
0%

0%
0%
0%

EnerPHit planning: **C O M P A R I S O N B**

Results are being calculated. Please wait…

Selection of comparison configuration

Description	9-Compl.Renovation
Component type	Complete building
Component	- No additional input

Calculation of selected configuration

	Lower Efficiency	Hig Effici
Design according to variant	1-No measures	5-Step 5(w:
Annual heating demand	228,397	18,
Minimal interior surface temperature	-	-
Design Temperature outside	-	-
Interior temperature	18,0	18
Normal surface thermal resistance	-	-
Increased Heat Transfer Resistance	-	-
Minimal surface temperature unobstructed	-	-

			Inves
	Per m² of TFA	Entire building	Per m² of TFA
Treated Floor Area (TFA)	1,00	719	1,00
Investment costs less sum of financial support	0,00	0	252,27
Annuity (capital costs)	0,00	0	15,20

			Energy (Space heating + c
	Per m² of TFA	Entire building	Per m² of TFA
Area	1	719	1
Annual heating demand	228,40	164307	18,48
Cooling + dehumidification demand			
Final energy demand	252,22	181446	57,10
CO_2-Emissions	63,44	45638	17,56
Primary energy demand	278,30	200205	70,10
Total cost space conditioning	22,85	16438	6,98

			Economi
Total annual costs	22,85	16438	22,19

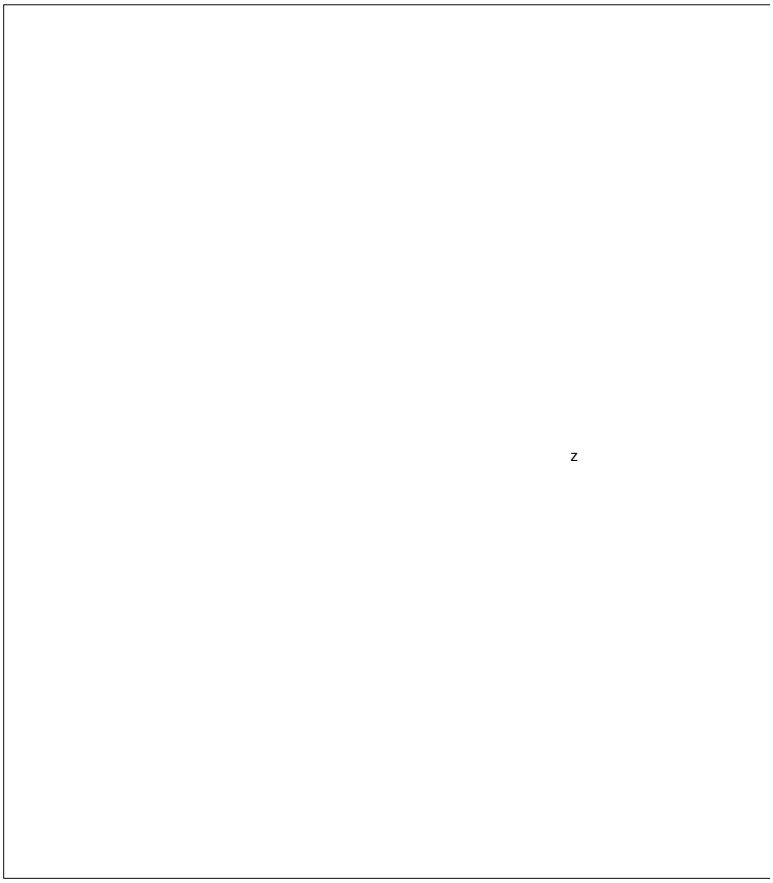
Maximal economically viable additional i

Cost per kWh of sa

<< Boundary conditions

Approximate estimate of cost effectiveness (all c

		Boundary
Interest rate + Inflation		**Energy price**
Nominal interest rate	6,50%	Electricity
Inflation	1,53%	Gas/Oil
Period under consideration [a]	20	Logs
		Pellet
		District heating
		Others



E T W E E N T W O V A R I A N T S

her ency	Difference / Savings / Profit	
indows in 2		
481	kWh(m²a)	
-	°C	
.	°C	
,0	°C	
.	m²K/W	
-	m²K/W	
-	°C	

tment			
Entire building	Per m² of TFA	Entire building	
719	1,00	719	m²
181478	252,27	181478	€
10937	**15,20**	**10937**	€/a

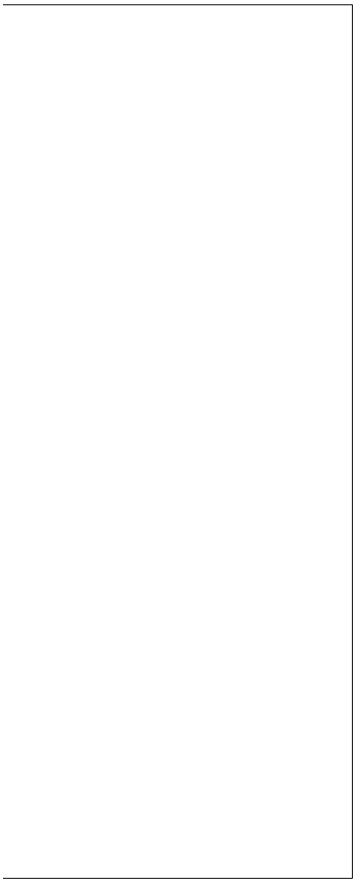
ooling + mech. ventilation)			
Entire building	Per m² of TFA	Entire building	
719	1	719	m²
13295	**209,92**	**151012**	kWh/a
			kWh/a
41076	195,12	140370	kWh/a
12631	45,88	33007	kg/a
50432	208,19	149772	kWh/a
5024	**15,87**	**11413**	€/a

c viability			
15961	**0,66**	**476**	€/a

investment costs	272,69	196170	€
aved final energy	7,8		Cent/kWh

omponents with the same mean lifetime)!

conditions			
s [cent/kWh]	Period of use		
25	Build. assemblies	50	a
9	Vent. system	25	cent/kWh
5	Thermal bridges	50	cent/kWh
7	Complete building	35	a
13	Windows	30	a
20			



Input: comparison configuration

	1	2
Description	S1:Roof	S2:Walls
Component type	Building assemblies ('U-Value')	Building assemblies ('U-Value')
Component	03ud Ventilated roof	01ud Brick walls
"Lower Efficiency" variant	1-No measures	2-Step 1 (only roof insulation)
Investment costs [€]	8.257,11	4.904,11
Annual maintenance costs [€/a]		
"Higher Efficiency" variant	2-Step 1 (only roof insulation)	3-Step 2 (only wall insulation, V
Investment costs [€]	20.985,65	32.934,54
Annual maintenance costs [€/a]		
Financial support (present value) [€]		

Results (manual transfer)

Description		
Investments in BGN - repear	16.149,51	9591,61
Investments in BGN - complete	41.044,36	64414,37
Maintenance costs in BGN/a		

3	4	5
S2:Ventilation	S2:Building	S3:Int.wall_ins
Ventilation system ('Ventilation'	Complete building	Building assemblies ('U-Value')
- No additional input	- No additional input	01ud Brick walls
2-Step 1 (only roof insulation)	2-Step 1 (roof insulation)	3-Step 2 (wall insulation, Ventila
2.996,76	7.900,88	
3-Step 2 (only wall insulation, V	3-Step 2 (wall insulation, Ventila	4-Step 3(interior wall insulation)
21.417,79	67.053,05	10.069,89
409,03	409,03	
5861,16	15452,77	
41889,56	131144,36	19694,99
800	800	

6	7	8
S3:Floor	S4:windows	S4:Building
Building assemblies ('U-Value')	Windows ('Window')	Complete building
06ud Floor	b-Without winter shading	- No additional input
3-Step 2 (wall insulation, Ventila	4-Step 3(interior wall insulation)	4-Step 3(interior wall insulation)
9.336,08		
4-Step 3(interior wall insulation)	5-Step 5(windows in 20 years), I	5-Step 5(windows in 20 years), I
15.775,23	54.836,05	67.593,81
18259,79		
30853,67	107250	132202

9	10
Compl.Renovation	
Complete building	
- No additional input	

1-No measures	

5-Step 5(windows in 20 years), DHW solar panels	
181.477,62	
409,03	

354939,38	
800	

EnerPHit planning:

CLIMATE DATA

Building: Primary School 8 "Sveti Sveti Kiril I Metodi" - Section C

Climate Building: Велико Търнов

Monthly Data: User data - Велико Търнов

Annual Data:

Use Annual Climate Data Set: no

Results:

Region: User Data

Climate data set: User data - Велико Търнов

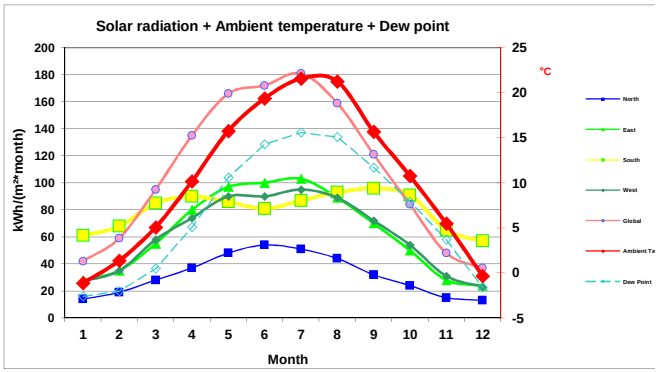
Weather station (altitude): 137,0 m

Building location (height above sea level): 426 m

Annual heating demand	54,7	kWh/(m²a)
Heating load	43,9	W/m²
Primary Energy	171,5	kWh/(m²a)

Transfer to annual method (Annual Heating)

H_T	194	d/a
G_t	77	kKh/a
North	127	kWh/(m²a)
East	251	kWh/(m²a)
South	444	kWh/(m²a)
West	253	kWh/(m²a)
Horizontal	417	kWh/(m²a)



Month	1	2	3	4	5	6	7	8	9	10	11	12	Heating load		Cooling
Days	31	28	31	30	31	30	31	31	30	31	30	31	Weather 1	Weather 2	Weather 1
Parameters for PHPP Calculated Ground Temperatures:	User data - Велико Търнов	Latitude:	43,1	Longitude °	25,7	Altitude m	137	Daily Temperature Swing Summer (K)			11,2	Radiation Data:	kWh/(m²month)	Radiation: W/m²		Radiatio
Phase shift months	Ambient Temp	-1,1	1,4	5,1	10,2	15,8	19,4	21,6	21,3	15,7	10,8	5,5	-0,3	-9,3	-4,8	27,9
0,60	North	14	19	28	37	48	54	51	44	32	24	15	13	19	16	92
Damping	East	28	35	55	80	97	100	103	89	70	50	28	24	39	23	197
-0,31	South	61	68	85	90	86	81	87	93	96	91	65	57	82	40	185
Depth m	West	27	35	58	74	90	90	95	89	72	54	31	23	35	24	197
1,00	Global	42	59	95	135	166	172	181	159	121	84	48	37	56	36	349
User data - Example	Dew Point	-2,6	-2,0	0,5	5,1	10,6	14,3	15,6	15,1	11,7	7,9	3,7	-1,6			18,6
1,00	Sky Temp	-11,1	-9,3	-6,3	-1,1	5,3	9,4	11,4	10,9	6,3	1,9	-2,6	-9,3			16,5
	Ground Temp	11,1	10,4	10,5	11,4	12,8	16,3	17,6	18,3	16,3	15,4	14,0	12,4	10,4	10,4	18,3

Building: Primary School 8 "Sveti Sveti Kiril I Metodi" - Section C

Wedge-shaped building assemblies (tapered insulation), unventilated air layers and unheated attics

-> Auxiliary calculation to the right

Assembly No.	Building assembly description	Interior insulation?
01ud	Brick walls	

Heat transfer resistance [m²K/W] interior Rsi : 0,13
exterior R_{se} : 0,04

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Inside plaster	0,700					40
2.	Bricks	0,520					250
3.	Outside plaster	0,870					40
4.	EPS	0,032					200
5.	Outside plaster	0,870					20
6.							
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2 | Percentage of sec. 3 | Total: 55,0 cm

U-value supplement W/(m²K) **U-Value:** 0,142 W/(m²K)

Assembly No.	Building assembly description	Interior insulation?
02ud	Concrete wall socle	

Heat transfer resistance [m²K/W] interior Rsi : 0,13
exterior R_{se} : 0,04

	Area section 2	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Inside plaster	0,700					20
2.	Concrete	0,520					400
3.	Boucharde	2,100					30
4.	EPS	0,032					200
5.	Outside plaster	0,870					20
6.							
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2 | Percentage of sec. 3 | Total: 67,0 cm

U-value supplement W/(m²K) **U-Value:** 0,138 W/(m²K)

Assembly No.	Building assembly description	Interior insulation?
03ud	Roof	

Heat transfer resistance [m²K/W] interior Rsi : 0,10
exterior R_{se} : 0,04

	Area section 3	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Reinforcement plaster	0,000					0
2.	Closed air	0,000					0
3.	Concrete	2,100					120
4.	Hydroinsulation	0,170					8
5.	balast/XPS	0,035					300
6.	new hydroinsulation	0,170					8
7.	balast new	3,500					40
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2 | Percentage of sec. 3 | Total: 47,5 cm

U-value supplement W/(m²K) **U-Value:** 0,113 W/(m²K)

Assembly No.	Building assembly description	Interior insulation?
04ud	Ground walls	yes

Heat transfer resistance [m²K/W] interior Rsi : 0,13
exterior R_{se} :

	Area section 4	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Inside plaster	0,700					20
2.	Concrete	2,100					400
3.	EPS	0,045					150
4.	Inside plaster	0,700					10
5.							
6.							
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2 | Percentage of sec. 3 | Total: 58,0 cm

U-value supplement W/(m²K) **U-Value:** 0,271 W/(m²K)

Assembly No.	Building assembly description	Interior insulation?
05ud	Floor to unheated basement	

Heat transfer resistance [m²K/W] interior Rsi : 0,17
exterior R_{se} : 0,17

	Area section 5	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Flooring	3,500					30
2.	Cement	0,930					20
3.	Concrete	2,100					150
4.	Plaster	0,700					20
5.							
6.							
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2 | Percentage of sec. 3 | Total: 22,0 cm

U-value supplement W/(m²K) **U-Value:** 2,127 W/(m²K)

Assembly No.	Building assembly description	Interior insulation?
06ud	Floor	yes

Heat transfer resistance [m²K/W] interior Rsi : 0,17
exterior R_{se} :

	Area section 6	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Flooring	3,500					30
2.	Cement	0,930					20
3.	Concrete	2,100					150
4.	Rubble	3,500					150
5.	XPS insulation	0,035					100
6.	New flooring	0,140					20
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2 | Percentage of sec. 3 | Total: 47,0 cm

U-value supplement W/(m²K) **U-Value:** 0,302 W/(m²K)

Assembly No.	Building assembly description	Interior insulation?
07ud	Inside brick wall	

Heat transfer resistance [m²K/W] interior Rsi : 0,13
exterior R_{se} : 0,04

	Area section 7	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Inside plaster	0,700					40
2.	Bricks	0,520					250
3.	Inside plaster	0,070					40
4.							
5.							
6.							
7.							
8.							
	Percentage of sec. 1		Percentage of sec. 2		Percentage of sec. 3		Total
	100%						33,0 cm

U-value supplement W/(m²K) **U-Value:** 0,782 W/(m²K)

Assembly No.	Building assembly description	Interior insulation?
08ud		

Heat transfer resistance [m²K/W] interior Rsi :
exterior R_{se} :

	Area section 8	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
	Percentage of sec. 1		Percentage of sec. 2		Percentage of sec. 3		Total
	100%						cm

U-value supplement W/(m²K) **U-Value:** W/(m²K)

Assembly No.	Building assembly description	Interior insulation?
09ud		

Heat transfer resistance [m²K/W] interior Rsi :
exterior R_{se} :

	Area section 9	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
	Percentage of sec. 1		Percentage of sec. 2		Percentage of sec. 3		Total
	100%						cm

U-value supplement W/(m²K) **U-Value:** W/(m²K)

EnerPHit planning: **U - V A L U E S O F B U I L D I N G E L E M I**

Assembly No. 10ud | Building assembly description | Interior insulation?

Heat transfer resistance [m²K/W] interior Rsi :
exterior R_{se} :

	Area section 10	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2 | Percentage of sec. 3 | Total cm

U-value supplement W/(m²K) **U-Value:** W/(m²K)

Assembly No. 11ud | Building assembly description | Interior insulation?

Heat transfer resistance [m²K/W] interior Rsi :
exterior R_{se} :

	Area section 11	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2 | Percentage of sec. 3 | Total cm

U-value supplement W/(m²K) **U-Value:** W/(m²K)

Assembly No. 12ud | Building assembly description | Interior insulation?

Heat transfer resistance [m²K/W] interior Rsi :
exterior R_{se} :

	Area section 12	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2 | Percentage of sec. 3 | Total cm

U-value supplement W/(m²K) **U-Value:** W/(m²K)

Assembly No. 13ud | Building assembly description | Interior insulation?

Heat transfer resistance [m²K/W] interior Rsi :

exterior R_{se} :

	Area section 13	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
	Percentage of sec. 1		Percentage of sec. 2		Percentage of sec. 3		Total
	100%						cm

U-value supplement W/(m²K) **U-Value:** W/(m²K)

Assembly No. 14ud | Building assembly description | Interior insulation?

Heat transfer resistance [m²K/W] interior Rsi :
exterior R_{se} :

	Area section 14	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
	Percentage of sec. 1		Percentage of sec. 2		Percentage of sec. 3		Total
	100%						cm

U-value supplement W/(m²K) **U-Value:** W/(m²K)

Assembly No. 15ud | Building assembly description | Interior insulation?

Heat transfer resistance [m²K/W] interior Rsi :
exterior R_{se} :

	Area section 15	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
	Percentage of sec. 1		Percentage of sec. 2		Percentage of sec. 3		Total
	100%						cm

U-value supplement W/(m²K) **U-Value:** W/(m²K)

Assembly No. 16ud | Building assembly description | Interior insulation?

Heat transfer resistance [m²K/W] interior Rsi :
exterior R_{se} :

	Area section 16	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]

1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								

Percentage of sec. 1: 100% | Percentage of sec. 2: | Percentage of sec. 3: | Total: cm

U-value supplement: W/(m²K) **U-Value:** W/(m²K)

Assembly No. 17ud | Building assembly description | Interior insulation?

Heat transfer resistance [m²K/W] interior Rsi : exterior R_{se} :

Area section 17	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						

Percentage of sec. 1: 100% | Percentage of sec. 2: | Percentage of sec. 3: | Total: cm

U-value supplement: W/(m²K) **U-Value:** W/(m²K)

Assembly No. 18ud | Building assembly description | Interior insulation?

Heat transfer resistance [m²K/W] interior Rsi : exterior R_{se} :

Area section 18	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						

Percentage of sec. 1: 100% | Percentage of sec. 2: | Percentage of sec. 3: | Total: cm

U-value supplement: W/(m²K) **U-Value:** W/(m²K)

Assembly No. 19ud | Building assembly description | Interior insulation?

Heat transfer resistance [m²K/W] interior Rsi : exterior R_{se} :

Area section 19	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.						
2.						
3.						
4.						

5.							
6.							
7.							
8.							
	Percentage of sec. 1		Percentage of sec. 2		Percentage of sec. 3		Total
	100%						cm

U-value supplement W/(m²K) **U-Value:** W/(m²K)

Assembly No. | Building assembly description | Interior insulation?

20ud

Heat transfer resistance [m²K/W] interior Rsi :
exterior R_{se} :

	Area section 20	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
	Percentage of sec. 1		Percentage of sec. 2		Percentage of sec. 3		Total
	100%						cm

U-value supplement W/(m²K) **U-Value:** W/(m²K)

Secondary Calculation: Equivalent Thermal Conductivity of Still Air Spaces

Air Layer Thickness		mm	Convective heat transfer	
Direction of the thermal flow:		Upwards	h_a	W/(m²K)
		Horizontal	Radiation heat transfer	
		Downwards	h_r	W/(m²K)
Emissivity of surface 1			equivalent thermal conductivity	
Emissivity of surface 2			λ	W/(mK)

Secondary Calculation: Equivalent Thermal Conductivity of Still Air Spaces

Air Layer Thickness	100	mm	Convective heat transfer	
of the	x	Upwards	h_a	1,95 W/(m²K)
		Horizontal	Radiation heat transfer	
		Downwards	h_r	4,17 W/(m²K)
Emissivity of surface 1	0,90		equivalent thermal conductivity	
Emissivity of surface 3	0,90		λ	**0,61** W/(mK)

Wedge-shaped layers (at an inclination of max. 5%)

(Calculation following EN 6946 Appendix C)

Assembly No.	Building assembly description
1a	Exemplary flat roof with wedge-shaped insulation

Heat transfer resistance [m²K/W] — interior Rsi: 0,10 — exterior R_{se}: 0,04

A parallel assemblies layer

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Total Width Thickness d_0 [mm]
1.	Concrete Ceiling	2,100					160
2.	PS Rigid Foam	0,040					200
3.							
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			36,0 cm

U_0:	0,192	W/(m²K)
R_0:	5,216	(m²K)/W

B Wedge-Shaped Assembly Layer

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness d_1 [mm]
PS rigid foam insulation	0,040					150

Percentage of sec. 2	Percentage of sec. 3	Thickness d_1 [cm]
		15,0 cm

U_1:	0,267	W/(m²K)
R_1:	3,750	(m²K)/W
Rectangular Area U-Value:	**0,144**	W/(m²K)
U-value of triangular area with the thickest point at the apex:	**0,157**	W/(m²K)
U-value of triangular area with the thinnest point at the apex:	**0,131**	W/(m²K)

Wedge-shaped layers (at an inclination of max. 5%)

(Calculation following EN 6946 Appendix C)

Assembly No.	Building assembly description
2a	

Heat transfer resistance [m²K/W] interior Rsi :

exterior R_{se} :

A parallel assemblies layer

Total Width

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness d_0 [mm]
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			cm

U_0: W/(m²K)

R_0: (m²K)/W

B Wedge-Shaped Assembly Layer

	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness d_1 [mm]

Percentage of sec. 2	Percentage of sec. 3	Thickness d_1 [cm]
		cm

U_1: W/(m²K)

R_1: (m²K)/W

Rectangular Area U-Value: W/(m²K)

U-value of triangular area with the thickest point at the apex: W/(m²K)

U-value of triangular area with the thinnest point at the apex: W/(m²K)

Non-conditioned attic

Building assembly description

Roof

Heat transfer resistance [m²K/W] interior Rsi : 0,17 Exterior absorption coefficient **0,80**

exterior R_{se} : 0,04 Exterior emissivity **0,93**

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Corrugated galvanised iro	60,000					3
2.							
3.							
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			0,3 cm

U-value supplement W/(m²K) **U-Value:** **4,761** W/(m²K)

Building assembly description

Exterior attic wall

Heat transfer resistance [m²K/W] interior Rsi : 0,13 Exterior absorption coefficient 0,80

exterior R_{se} : 0,04 Exterior emissivity 0,93

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Interior plaster	0,350					15
2.	Masonry	1,100					175
3.	Exterior Render	0,800					20
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			21,0 cm

U-value supplement W/(m²K) **U-Value:** **2,519** W/(m²K)

Building assembly description

Intermediate ceiling

Heat transfer resistance [m²K/W] interior Rsi : 0,17

exterior R_{se} : 0,17

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Wooden floor	0,130					22
2.							
3.							
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
83%	16,7%		2,2 cm

U-value supplement W/(m²K)

U-Value: 1,964 W/(m²K)

Attic area

Roof area	200,0	m²
Area of exterior walls and attic	200,0	m²
Area of intermediate ceiling	100,0	m²

emissivity in the attic

Inner side of the roof / exterior wall	0,93
Upper side of the interior ceiling	0,93

Air exchange in the attic

Air change rate	0,20	1/h
Volume	200,0	m³

Equivalent value for the intermediate ceiling (to be linked to worksheets "Components" and "Areas"')

U-Value: 2,732 **Absorptivity: 0,780** **Emissivity: 0,907**

Total solar energy transmittance (informative): 0,085

EnerPHit planning: # AREAS DETERMINATION

Building: Primary School 8 "Sveti Sveti Kiril I Metodij" Se Heating demand 55 kWh/(m²a)

Summary

Group Nr.	Area group	Temp.-zone	Area	Unit	Comment		Building assembly overview	Average U-Value [W/(m²K)]	Radiation-gains heating season	Radiation-load cooling period [kWh/a]
1	Treated Floor Area		719,39	m²	*Treated floor area according to PHPP manual*				7 months	8 months
2	North Windows	A	0,00	m²			North Windows			
3	East Windows	A	101,98	m²	Results come from the 'Windows' worksheet.		East Windows	2,745	7485	11983
4	South Windows	A	22,14	m²	Window areas are subtracted from individual opaque areas.		South Windows	2,827	502	1524
5	West Windows	A	103,69	m²	which is displayed in the "Windows" worksheet.		West Windows	2,737	5624	6456
6	Horizontal Windows	A	0,00	m²			Horizontal Windows			
7	Exterior Door	A	2,53	m²	*Please subtract area of door from respective building assembly*		Exterior Door	2,250		
8	Exterior Wall - Ambient	A	518,51	m²	*Temperature Zone "A" is ambient air.*		Exterior Wall - Ambient	0,141	29	265
9	Exterior Wall - Ground	B	235,86	m²	*Temperature zone "B" is the ground.*		Exterior Wall - Ground	0,271		
10	Roof/Ceiling - Ambient	A	400,34	m²			Roof/Ceiling - Ambient	0,113	366	1186
11	Floor slab / basement ceiling	B	400,34	m²			Floor slab / basement ceiling	0,302		
12	Floor over unheated base	B	0,00	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"*		Floor over unheated basement			
13			0,00	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"*	Factor for X				
14		X	0,00	m²	*Temperature zone "X": Please provide user-defined reduction factor (0 < f, < 1):*	75%				
							Thermal bridges - Overview	Ψ [W/(mK)]		
15	Thermal Bridges Ambient	A	164,60	m	*Units in m*		Thermal Bridges Ambient	0,087		
16	Perimeter Thermal Bridges	P	59,10	m	*Units in m; temperature zone "P" is perimeter (see Ground worksheet).*		Perimeter Thermal Bridges	-0,028		
17	Thermal bridges FS/BC	B	0,00	m	*Units in m*		Thermal bridges FS/BC			
18	Partition Wall to Neighbour	I	28,60	m²	*No heat losses, only considered for the heating load calculation.*		Partition Wall to Neighbour	0,782		
Total thermal envelope			1785,39	m²			Average Therm. Envelope	0,531		

Go to building components list

Area input

Sort: AS LIST

Area Nr.	Building assembly description	Group Nr.	Assigned to group	Quan-tity	x (	a [m]	x	b [m]	+	User-Deter-mined [m²]	-	User Sub-traction [m²]	-	Subtraction window areas [m²]	) =	Area [m²]	Selection of building element assembly / certified building system	Nr.	Description (certified component)	U-Value [W/(m²K)]	Deviation from North	Angle of inclination from the horizontal	Orientation	Reduction factor shading	Exterior absorptivity	Exterior emissivity
	Treated floor area	1	Treated Floor Area	1	x (		x		+	719,39	-				) =	719,4										
	North Windows	2	North Windows													0,0	From 'Windows' worksheet			0,000						
	East Windows	3	East Windows													102,0	From 'Windows' worksheet			2,745						
	South Windows	4	South Windows													22,1	From 'Windows' worksheet			2,827						
	West Windows	5	West Windows													103,7	From 'Windows' worksheet			2,737						
	Horizontal Windows	6	Horizontal Windows													0,0	From 'Windows' worksheet			0,000						
	Exterior Door	7	Exterior Door	1	x (	1,10	x	2,30	+		-		) -		=	2,5	U-value exterior door:			2,25						
1	Gym west	8	Exterior Wall - Ambient	1	x (	30,35	x	5,45	+		-		) -	68,1	=	97,4	01ud Brick walls			0,142	260	90	West	0,70	0,40	0,90
2	Gym north	8	Exterior Wall - Ambient	1	x (	12,40	x	5,45	+		-		) -	0,0	=	67,6	01ud Brick walls			0,142	0	90	North	0,70	0,40	0,90
3	Gym east	8	Exterior Wall - Ambient	1	x (	30,35	x	5,45	+		-		) -	69,4	=	96,0	01ud Brick walls			0,142	90	90	East	0,70	0,40	0,90
4	Gym south	8	Exterior Wall - Ambient	1	x (	12,40	x	5,45	+		-	14,20	) -	18,9	=	34,5	01ud Brick walls			0,142	180	90	South	0,70	0,40	0,90
5	Corridor west	8	Exterior Wall - Ambient	1	x (	6,00	x	3,55	+		-		) -	12,5	=	8,8	01ud Brick walls			0,142	260	90	West	0,70	0,40	0,90
6	Corridor east	8	Exterior Wall - Ambient	1	x (	6,00	x	3,55	+		-		) -	9,4	=	11,9	01ud Brick walls			0,142	90	90	East	0,70	0,40	0,90
7	Gym west ground	9	Exterior Wall - Ground	1	x (	30,35	x	5,20	+		-	83,46	) -	0,0	=	74,4	04ud Ground walls			0,271						
8	Gym north ground	9	Exterior Wall - Ground	1	x (	12,40	x	5,20	+		-	39,06	) -	0,0	=	25,4	04ud Ground walls			0,271						
9	Gym east ground	9	Exterior Wall - Ground	1	x (	30,35	x	5,20	+		-	83,46	) -	0,0	=	74,4	04ud Ground walls			0,271						
10	Gym south ground	9	Exterior Wall - Ground	1	x (	12,40	x	5,20	+		-	20,16	) -	0,0	=	44,3	04ud Ground walls			0,271						
11	Corridor west	9	Exterior Wall - Ground	1	x (	6,00	x	3,60	+		-	12,90	) -	0,0	=	8,7	04ud Ground walls			0,271						
12	Corridor east	9	Exterior Wall - Ground	1	x (	6,00	x	3,60	+		-	12,90	) -	0,0	=	8,7	04ud Ground walls			0,271						
13	Roof gym	10	Roof/Ceiling - Ambient	1	x (	30,35	x	12,40	+		-		) -	0,0	=	376,3	03ud Ventilated roof			0,113	0	0	Hor	0,70	0,90	0,90
14	Roof corridor	10	Roof/Ceiling - Ambient	1	x (	6,00	x	4,00	+		-		) -	0,0	=	24,0	03ud Ventilated roof			0,113	0	0	Hor	0,70	0,90	0,90
15	Floor gym	11	Floor slab / basement ceiling	1	x (	30,35	x	12,40	+		-		) -	0,0	=	376,3	06ud Floor			0,302						
16	Floor corridor	11	Floor slab / basement ceiling	1	x (	6,00	x	4,00	+		-		) -	0,0	=	24,0	06ud Floor			0,302						
17	Gym cocle west	8	Exterior Wall - Ambient	1	x (		x		+	83,46	-		) -	17,8	=	65,7	02ud Concrete wall socle			0,138	260	90	West	0,70	0,40	0,90
18	Gym cocle north	8	Exterior Wall - Ambient	1	x (		x		+	39,06	-		) -	0,0	=	39,1	02ud Concrete wall socle			0,138	0	90	North	0,70	0,40	0,90
19	Gym cocle east	8	Exterior Wall - Ambient	1	x (		x		+	83,46	-		) -	17,8	=	65,6	02ud Concrete wall socle			0,138	90	90	East	0,70	0,40	0,90
20	Gym cocle south	8	Exterior Wall - Ambient	1	x (		x		+	20,16	-		) -	3,2	=	16,9	02ud Concrete wall socle			0,138	180	90	South	0,70	0,40	0,90
21	Corridor cocle west	8	Exterior Wall - Ambient	1	x (		x		+	12,90	-		) -	5,4	=	7,5	02ud Concrete wall socle			0,138	260	90	West	0,70	0,40	0,90
22	Corridor cocle east	8	Exterior Wall - Ambient	1	x (		x		+	12,90	-		) -	5,4	=	7,5	02ud Concrete wall socle			0,138	90	90	East	0,70	0,40	0,90
23	Wall to Sector C	18	Partition Wall to Neighbour	1	x (	4,00	x	7,15	+		-		) -	0,0	=	28,6	07ud Inside brick wall			0,782	180	90	South			
24					x (		x		+		-		) -	0,0	=											
25					x (		x		+		-		) -	0,0	=											
26					x (		x		+		-		) -	0,0	=											
27					x (		x		+		-		) -	0,0	=											
28					x (		x		+		-		) -	0,0	=											
29					x (		x		+		-		) -	0,0	=											
30					x (		x		+		-		) -	0,0	=											
31					x (		x		+		-		) -	0,0	=											
32					x (		x		+		-		) -	0,0	=											
33					x (		x		+		-		) -	0,0	=											
34					x (		x		+		-		) -	0,0	=											
35					x (		x		+		-		) -	0,0	=											

Please complete in Windows worksheet only!

EnerPHit planning: **AREAS DETERMINATION**

Building: Primary School 8 "Sveti Sveti Kiril I Metodij" Se... Heating demand 55 kWh/(m²a)

Summary

Group Nr.	Area group	Temp.-zone	Area	Unit	Comment
1	**Treated Floor Area**		**719,39**	m²	*Treated floor area according to PHPP manual*
2	**North Windows**	**A**	**0,00**	m²	
3	**East Windows**	**A**	**101,98**	m²	Results come from the 'Windows' worksheet.
4	**South Windows**	**A**	**22,14**	m²	Window areas are subtracted from individual opaque areas.
5	**West Windows**	**A**	**103,69**	m²	which is displayed in the "Windows" worksheet.
6	**Horizontal Windows**	**A**	**0,00**	m²	
7	**Exterior Door**	**A**	**2,53**	m²	*Please subtract area of door from respective building assembly*
8	**Exterior Wall - Ambient**	**A**	**518,51**	m²	*Temperature Zone "A" is ambient air.*
9	**Exterior Wall - Ground**	**B**	**235,86**	m²	*Temperature zone "B" is the ground.*
10	**Roof/Ceiling - Ambient**	**A**	**400,34**	m²	
11	**Floor slab / basement ceiling**	**B**	**400,34**	m²	
12	**Floor over unheated base**	**B**	**0,00**	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"*
13			**0,00**	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"* Factor for X
14		**X**	**0,00**	m²	*Temperature zone "X": Please provide user-defined reduction factor (0 < f, < 1):* **75%**
15	**Thermal Bridges Ambient**	**A**	**164,60**	m	*Units in m*
16	**Perimeter Thermal Bridges**	**P**	**59,10**	m	*Units in m; temperature zone "P" is perimeter (see Ground worksheet).*
17	**Thermal bridges FS/BC**	**B**	**0,00**	m	*Units in m*
18	**Partition Wall to Neighbour**	**I**	**28,60**	m²	*No heat losses, only considered for the heating load calculation.*
Total thermal envelope			**1785,39**	**m²**	

Building assembly overview	Average U-Value [W/(m²K)]	Radiation-gains heating season	Radiation-load cooling period [kWh/a]
		7 months	**8 months**
North Windows			
East Windows	**2,745**	**7485**	**11983**
South Windows	**2,827**	**502**	**1524**
West Windows	**2,737**	**5624**	**6456**
Horizontal Windows			
Exterior Door	**2,250**		
Exterior Wall - Ambient	**0,141**	**29**	**265**
Exterior Wall - Ground	**0,271**		
Roof/Ceiling - Ambient	**0,113**	**366**	**1186**
Floor slab / basement ceiling	**0,302**		
Floor over unheated basement			
Thermal bridges - Overview	**Ψ [W/(mK)]**		
Thermal Bridges Ambient	**0,087**		
Perimeter Thermal Bridges	**-0,028**		
Thermal bridges FS/BC			
Partition Wall to Neighbour	0,782		
Average Therm. Envelope	**0,531**		

Go to building components list

36					x (		x		+		-		) -	0,0	=																
37					x (		x		+		-		) -	0,0	=																
38					x (		x		+		-		) -	0,0	=																
39					x (		x		+		-		) -	0,0	=																
40					x (		x		+		-		) -	0,0	=																
41					x (		x		+		-		) -	0,0	=																
42					x (		x		+		-		) -	0,0	=																
43					x (		x		+		-		) -	0,0	=																
44					x (		x		+		-		) -	0,0	=																
45					x (		x		+		-		) -	0,0	=																
46					x (		x		+		-		) -	0,0	=																
47					x (		x		+		-		) -	0,0	=																
48					x (		x		+		-		) -	0,0	=																
49					x (		x		+		-		) -	0,0	=																
50					x (		x		+		-		) -	0,0	=																
Aend																															

EnerPHit planning: # AREAS DETERMINATION

Building: Primary School 8 "Sveti Sveti Kiril I Metodi" Sa Heating demand 55 kWh/(m²a)

Summary

Group Nr.	Area group	Temp.-zone	Area	Unit	Comment		Building assembly overview	Average U-Value [W/(m²K)]	Radiation-gains heating season	Radiation-load cooling period
1	Treated Floor Area		719,39	m²	*Treated floor area according to PHPP manual*				7 months	8 months
2	North Windows	A	0,00	m²			North Windows			
3	East Windows	A	101,98	m²	Results come from the 'Windows' worksheet.		East Windows	2,745	7485	11983
4	South Windows	A	22,14	m²	Window areas are subtracted from individual opaque areas.		South Windows	2,827	502	1524
5	West Windows	A	103,69	m²	which is displayed in the "Windows" worksheet.		West Windows	2,737	5624	6456
6	Horizontal Windows	A	0,00	m²			Horizontal Windows			
7	Exterior Door	A	2,53	m²	*Please subtract area of door from respective building assembly*		Exterior Door	2,250		
8	Exterior Wall - Ambient	A	518,51	m²	*Temperature Zone "A" is ambient air.*		Exterior Wall - Ambient	0,141	29	265
9	Exterior Wall - Ground	B	235,86	m²	*Temperature zone "B" is the ground.*		Exterior Wall - Ground	0,271		
10	Roof/Ceiling - Ambient	A	400,34	m²			Roof/Ceiling - Ambient	0,113	366	1186
11	Floor slab / basement ceiling	B	400,34	m²			Floor slab / basement ceiling	0,302		
12	Floor over unheated base	B	0,00	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"*		Floor over unheated basement			
13			0,00	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"*	Factor for X				
14		X	0,00	m²	*Temperature zone "X": Please provide user-defined reduction factor (0 < f_x < 1):*	75%				
							Thermal bridges - Overview	Ψ [W/(mK)]		
15	Thermal Bridges Ambient	A	164,60	m	*Units in m*		Thermal Bridges Ambient	0,087		
16	Perimeter Thermal Bridges	P	59,10	m	*Units in m; temperature zone "P" is perimeter (see Ground worksheet).*		Perimeter Thermal Bridges	-0,028		
17	Thermal bridges FS/BC	B	0,00	m	*Units in m*		Thermal bridges FS/BC			
18	Partition Wall to Neighbour	I	28,60	m²	*No heat losses, only considered for the heating load calculation.*		Partition Wall to Neighbour	0,782		
Total thermal envelope			1785,39	m²			Average Therm. Envelope	0,531		

Go to building components list

Thermal Bridge Inputs

Nr.	Thermal bridge description	Group Nr.	Assigned to group	Quantity	x (	User determined length [m]	-	Subtraction user-determined length [m]	)=	Length ℓ [m]	Input of thermal bridge heat loss coefficient W/(mK)	Ψ W/(mK)
1	Heated basement perimete	16	Perimeter Thermal Bridges	1	x (	59,10	-		) =	59,10	Heated basement perimeter	-0,028
2	Connection to Block C	15	Thermal Bridges Ambient	1	x (	4,00	-		) =	4,00	Connection to Block C	0,029
3	Roof perimeter	15	Thermal Bridges Ambient	1	x (	72,70	-		) =	72,70	Roof perimeter	0,055
4	Connection Blocks D&D1	15	Thermal Bridges Ambient	1	x (	4,00	-		) =	4,00	Connection Blocks D&D1	0,029
5	Outside - inside wall in	15	Thermal Bridges Ambient	1	x (	59,10	-		) =	59,10	Outside - inside wall insulation	0,109
6	Roof perimeter ^	15	Thermal Bridges Ambient	1	x (	24,80	-		) =	24,80	Roof perimeter ^	0,148
7					x (		-		) =			
8					x (		-		) =			
9					x (		-		) =			
10					x (		-		) =			
11					x (		-		) =			
12					x (		-		) =			
13					x (		-		) =			
14					x (		-		) =			
15					x (		-		) =			
16					x (		-		) =			
17					x (		-		) =			
18					x (		-		) =			
19					x (		-		) =			
20					x (		-		) =			
21					x (		-		) =			
22					x (		-		) =			
23					x (		-		) =			
24					x (		-		) =			
25					x (		-		) =			
26					x (		-		) =			
27					x (		-		) =			
28					x (		-		) =			
29					x (		-		) =			
30					x (		-		) =			
31					x (		-		) =			
32					x (		-		) =			
33					x (		-		) =			
34					x (		-		) =			
35					x (		-		) =			
36					x (		-		) =			
37					x (		-		) =			
38					x (		-		) =			
39					x (		-		) =			

EnerPHit planning: # AREAS DETERMINATION

Building: Primary School 8 "Sveti Sveti Kiril I Metodi" Heating demand 55 kWh/(m²a)

Summary

Group Nr.	Area group	Temp.-zone	Area	Unit	Comment		Building assembly overview	Average U-Value [W/(m²K)]	Radiation-gains heating season	Radiation-load cooling period
1	**Treated Floor Area**		**719,39**	m²	*Treated floor area according to PHPP manual*				**7 months**	**8 months**
2	**North Windows**	**A**	**0,00**	m²			**North Windows**			
3	**East Windows**	**A**	**101,98**	m²	Results come from the 'Windows' worksheet.		**East Windows**	**2,745**	**7485**	**11983**
4	**South Windows**	**A**	**22,14**	m²	Window areas are subtracted from individual opaque areas.		**South Windows**	**2,827**	**502**	**1524**
5	**West Windows**	**A**	**103,69**	m²	which is displayed in the "Windows" worksheet.		**West Windows**	**2,737**	**5624**	**6456**
6	**Horizontal Windows**	**A**	**0,00**	m²			**Horizontal Windows**			
7	**Exterior Door**	**A**	**2,53**	m²	*Please subtract area of door from respective building assembly*		**Exterior Door**	**2,250**		
8	**Exterior Wall - Ambient**	**A**	**518,51**	m²	*Temperature Zone "A" is ambient air.*		**Exterior Wall - Ambient**	**0,141**	**29**	**265**
9	**Exterior Wall - Ground**	**B**	**235,86**	m²	*Temperature zone "B" is the ground.*		**Exterior Wall - Ground**	**0,271**		
10	**Roof/Ceiling - Ambient**	**A**	**400,34**	m²			**Roof/Ceiling - Ambient**	**0,113**	**366**	**1186**
11	**Floor slab / basement ceiling**	**B**	**400,34**	m²			**Floor slab / basement ceiling**	**0,302**		
12	**Floor over unheated base**	**B**	**0,00**	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"*		**Floor over unheated basement**			
13			**0,00**	m²	*Temperature zones "A", "B","P" and "X" may be used. NOT "I"*	Factor for X				
14		**X**	**0,00**	m²	*Temperature zone "X": Please provide user-defined reduction factor (0 < f_x < 1):*	**75%**				
							Thermal bridges - Overview	**Ψ [W/(mK)]**		
15	**Thermal Bridges Ambient**	**A**	**164,60**	m	*Units in m*		**Thermal Bridges Ambient**	**0,087**		
16	**Perimeter Thermal Bridges**	**P**	**59,10**	m	*Units in m; temperature zone "P" is perimeter (see Ground worksheet).*		**Perimeter Thermal Bridges**	**-0,028**		
17	**Thermal bridges FS/BC**	**B**	**0,00**	m	*Units in m*		**Thermal bridges FS/BC**			
18	**Partition Wall to Neighbour**	**I**	**28,60**	m²	*No heat losses, only considered for the heating load calculation.*		**Partition Wall to Neighbour**	0,782		
Total thermal envelope			**1785,39**	**m²**			**Average Therm. Envelope**	**0,531**		

Go to building components list

40					x (		-		) =			
41					x (		-		) =			
42					x (		-		) =			
43					x (		-		) =			
44					x (		-		) =			
45					x (		-		) =			
46					x (		-		) =			
47					x (		-		) =			
48					x (		-		) =			
49					x (		-		) =			
50					x (		-		) =			

TBend

A tool for thermal bridge conversion to exterior dimensions					
Description		Units	Example		
	Ψ Interior Dimensions	W/(mK)	0,027		
	Temperature Diff. TB	K	30,000		
Adjacent Aarea I	Temperature Diff. Δϑ I	K	30,000		
	Exterior - Interior Dim. I	m	0,400		
	U-Value building assembly I	W/(m²K)	0,138		
Adjacent Area II	Temperature Diff. Δϑ II	K	30,000		
	Exterior - Interior Dim. II	m	0,300		
	U-Value building assembly II	W/(m²K)	0,110		
	Ψ Exterior Dimensions	W/(mK)	-0,061		

EnerPHit planning:

HEAT LOSSES THROUGH THE GROUND

Building part 1

Ground characteristics			
Thermal conductivity	λ	2,0	W/(mK)
Heat capacity	ρc	2,0	MJ/(m³K)
Periodic Penetration Depth	δ	3,17	m

Climate data			
Av. Indoor Temp. Winter	T_i	18,0	°C
Av. Indoor Temp. Summer	T_i	24,0	°C
Average Ground Surface Temperature	$T_{g,ave}$	11,4	°C
Amplitude of $T_{g,ave}$	$T_{g,\wedge}$	11,4	°C
Phase shifting of $T_{e,m}$	τ	1,0	Months
Length of the Heating Period	n	6,4	Months
Heating Degree Hours - Exterior	G_t	67,4	kKh/a

Building data							
Area of ground floor slab / basement ceiling	A	400,3	m²	U-value floor slab/basement ceiling	U_f	0,302	W/(m²K)
Perimeter length	P	133,7	m	Thermal bridges floor slab/basement ceiling	Ψ_B*l	0,00	W/K
Charact. Dimension of floor slab	B'	5,99	m	U-value floor slab / basement ceiling incl. TB	U_f'	0,302	W/(m²K)
				Eq. Thickness Floor	d_t	6,63	m

Floor Slab Type (select only one)

	Slab on Grade						
	Perimeter Insulation Width/Depth	D	m	Orientation of the Perimeter Ins.	horizontal		
	Perimeter Insulation Thickness	d_n	m	(check only one field)	vertical	x	
	Conductivity perimeter insulation	λ_n	W/(mK)				
x	**Heated basement or floor slab completely / partially below ground level**						
	Basement wall height below ground level	z	2,09 m	U-Value below ground wall	U_{wB}	0,271	W/(m²K)
	Unheated basement						
	Height aboveground wall	h	m	U-Value above ground wall	U_W		W/(m²K)
	Basement wall height below ground level	z	m	U-Value below ground wall	U_{wB}		W/(m²K)
	Air Change Unheated Basement	n	h^{-1}	U-Value Basement Floor Slab	U_{fB}		W/(m²K)
	Air flow basement	V	m³				
	Suspended Floor Above a Ventilated Crawl Space (at max. 0.5 m Below Ground)						
	U-Value Crawl Space	U_{Crawl}	W/(m²K)	Area of Ventilation Openings	εP		m²
	Height of crawl space wall	h	m	Wind Velocity at 10 m Height	v	4,0	m/s
	U-Value crawl space wall	U_W	W/(m²K)	Wind Shield factor	f_W	0,05	-

Additional Thermal Bridge Heat Losses at Perimeter							
				Steady-State Fraction	$\Psi_{P,stat}$*l	-1,655	W/K
Phase shift	β		Months	Harmonic Fraction	$\Psi_{P,harm}$*l	-1,655	W/K

Groundwater correction							
Depth of the Groundwater Table	z_w	3,0	m	Groundwater Correction Factor	G_w	1,01144049	-
Groundwater flow rate	q_w	0,05	m/d				

Interim Results

Phase shift	β	1,34	Months	Steady-state heat flow	Φ_{stat}	890,8	W
Steady-state transmittance	L_S	135,30	W/K	Periodic Heat Flow	Φ_{harm}	271,3	W
Exterior Periodic transmittance	L_{pe}	52,41	W/K	Heat Losses During Heating Period	Q_{tot}	5410	kWh
Transmittance building	L_0	194,73	W/K				

Monthly Average temperatures in the ground for monthly method (building assembly 1)

Month	1	2	3	4	5	6	7	8	9	10	11	12	Average value
Winter	11,1	10,4	10,5	11,4	12,8	14,4	15,7	16,4	16,3	15,4	14,0	12,4	13,4
Summer	12,9	12,3	12,4	13,3	14,7	16,3	17,6	18,3	18,1	17,3	15,8	14,3	15,3

Design ground temperature for 'Heating load' worksheet 10,4 **For 'Cooling load' worksheet** 18,3

Reduction factor for 'Annual heating' worksheet 0,41

Total result (all building parts)

Phase shift	β	1,34	Months	Steady-state heat flow	Φ_{stat}	890,8	W
Steady-state transmittance	L_S	135,30	W/K	Periodic Heat Flow	Φ_{harm}	271,3	W
Exterior Periodic transmittance	L_{pe}	52,41	W/K	Heat Losses During Heating Period	Q_{tot}	5410	kWh
Transmittance building	L_0	194,73	W/K	Charact. Dimension of floor slab	B'	5,99	m

Monthly Average temperatures in the ground for monthly method (all building assemblies)

Month	1	2	3	4	5	6	7	8	9	10	11	12	Average value
Winter	11,1	10,4	10,5	11,4	12,8	14,4	15,7	16,4	16,3	15,4	14,0	12,4	13,4
Summer	12,9	12,3	12,4	13,3	14,7	16,3	17,6	18,3	18,1	17,3	15,8	14,3	15,3

Design ground temperature for 'Heating load' worksheet 10,4 **For 'Cooling load' worksheet** 18,3

Reduction factor for 'Annual heating' worksheet 0,41

Either there are inconsistencies between the building assemblies in contact with the ground entered in the worksheets 'Areas' and 'Ground' OR you made an incorrect selection of the typ

Go to: 'AREAS' | http://www.passiv.de/komponentendatenbank/en-EN
Glazing | Ventilation units
Window frame | Compact units

Building assemblies (U-values)

		1			
ID	**Building system**	**Building assembly**	**Total thickness**	**U-Value**	**Interior insulation**
	Summary of the constructions calculated in 'U values' worksheet		m	W/(m²K)	-
01ud	Brick walls	Brick walls	0,550	0,142	
02ud	Concrete wall socle	Concrete wall socle	0,670	0,138	
03ud	Roof	Roof	0,475	0,113	
04ud	Ground walls	Ground walls	0,580	0,271	yes
05ud	Floor to unheated basement	Floor to unheated basement	0,220	2,127	
06ud	Floor	Floor	0,470	0,302	yes
07ud	Inside brick wall	Inside brick wall	0,330	0,782	
08ud					
09ud					
10ud					

Glazing

Glazing

ID	Description	g-Value	U_g-Value
			W/(m²K)
01ud	44 mm. triple glazing, 2 Low-E, air, alum.spacer	0,51	0,80
02ud			
03ud			
04ud			
05ud			
06ud			
07ud			
08ud			
09ud			
10ud			

Window frames

Window frames

		U_f-Value				Frame Width				Glazing edge thermal bridge				Installation thermal bridge				Curtain wall facades:
ID	Description	left	right	bottom	above	left	right	bottom	above	$\Psi_{Glazing\ edge}$ left	$\Psi_{Glazing\ edge}$ right	$\Psi_{Glazing\ edge}$ bottom	$\Psi_{Glazing\ edge}$ top	$\Psi_{Installation}$ left	$\Psi_{Installation}$ right	$\Psi_{Installation}$ bottom	$\Psi_{Installation}$ top	χ_{GC} -value Glass carrier
		W/(m²K)	W/(m²K)	W/(m²K)	W/(m²K)	m	m	m	m	W/(mK)	W/(mK)	W/(mK)	W/(mK)	W/(mK)	W/(mK)	W/(mK)	W/(mK)	W/K
01ud	Plastic window frame good	1,60	1,60	1,60	1,60	0,140	0,140	0,140	0,140	0,040	0,040	0,040	0,040	0,040	0,040	0,040	0,040	
02ud	VEKA AG ALPHALINE 90 MD	0,97	0,97	0,97	0,97	0,118	0,118	0,118	0,118	0,030	0,030	0,030	0,030	0,040	0,040	0,040	0,040	
03ud	Aluminium window frame, thermally separated	2,40	2,40	2,40	2,40	0,140	0,140	0,140	0,140	0,040	0,040	0,040	0,040	0,040	0,040	0,040	0,040	
04ud																		
05ud																		
06ud																		
07ud																		
08ud																		
09ud																		
10ud																		

Ventilation units with heat recovery

Ventilation units with heat recovery

					Additional Device Data								
ID	Description	Heat recovery efficiency	Energy recovery value η_{FRG}	Electric efficiency	Entry area		External pressure per line	Fittings Δp_{intern}	Frost protection required	Noise protection			Additional info
	User defined area	%	%	Wh/m³	m³/h	m³/h	Pa	Pa		35 dB(A)	Supply air dB(A)	Extract air dB(A)	
01ud	Heat recovery unit	83%		0,40									
02ud	Tangra ventilation unit EVB 06 HiE	82%	0%	0,40	200	600	100	incl.	yes	–	57	57	
03ud	Tangra ventilation unit EVB 04 HiE	82%	0%	0,40	100	400	100	incl.	yes	–	61	61	
04ud													
05ud	Tangra ventilation unit EVB 16 HiE	82%	0%	0,40	400	1600	100	incl.	yes				
06ud	Tangra ventilation unit EVB 18 HiE	82%	0%	0,40	600	1800	100	incl.	yes				
07ud	Some other	82%	0%	0,40	800	3000	100						
08ud													
09ud													
10ud													

REDUCTION FACTOR SOLAR RADIATION, WINDOW U-VALUE

Building: Primary School 8 "Sveti Sveti Kiril I Metodi" - Section C

Annual heating demand: 55 kWh/(m²a)

Heating degree hours: 67,4

Climate: User data - Велико Търнов

Window area orientation	Global radiation (cardinal points)	Shading	Dirt	Non-perpendicular incident radiation	Glazing fraction	g-Value	Solar radiation reduction factor	Window area	Window U-Value	Glazing area	Average global radiation	Transmission losses	Heat gains solar radiation
maximum:	kWh/(m²a)	0,75	0,95	0,85				m²	W/(m²K)	m²	kWh/(m²a)	kWh/a	kWh/a
North	127	1,00	0,95	0,85	0,000	0,00	0,00	0,00	0,00	0,00	127	0	0
East	251	0,78	0,95	0,85	0,507	0,77	0,32	101,98	2,74	51,73	251	18857	6254
South	444	0,13	0,95	0,85	0,532	0,77	0,06	22,14	2,83	11,78	444	4216	430
West	253	0,51	0,95	0,85	0,512	0,77	0,21	103,69	2,74	53,08	281	19122	4723
Horizontal	417	1,00	0,95	0,85	0,000	0,00	0,00	0,00	0,00	0,00	417	0	0
Total or Average Value for All Windows.						0,77	0,24	227,81	2,75	116,59		42195	11407

Go to glazing list Go to window frames list

Quantity	Description	Deviation from North	Angle of inclination from the horizontal	Orientation	Window rough openings: Width	Window rough openings: Height	installed in: Selection from worksheet 'Areas'	Glazing: Selection from worksheet 'Components'	Frame: Selection from worksheet 'Components'	g-Value: Perpendicular Radiation	U-Value: Glazing	U-Value: Frames (centre)	Ψ Glazing edge: Ψ_{spacer} (centre)	Installation situation: left	right	bottom	above	$\Psi_{installation}$ (Average)	Results: Window Area	Glazing Area	U-Value Window	Glazed fraction per window	Transmission-losses	Solar gains
		Degrees	Degrees		m	m		Sort: AS LIST	Sort: AS LIST	-	W/(m²K)	W/(m²K)	W/(mK)	W/(mK) or 1/0				W/(mK)	m²	m²	W/(m²K)	%	kWh/a	kWh/a
20	Gym Type 1	260	90	West	0,600	1,350	17-Gym cocle west	94ud Double glazing 4/16mm air/4	03ud Aluminium window frame, thermally	0,77	2,70	2,40	0,040	1	1	1	1	0,040	16,2	6,85	2,86	42%	3118	538
22	Gym Type 1	90	90	East	0,600	1,350	19-Gym cocle east	94ud Double glazing 4/16mm air/4	03ud Aluminium window frame, thermally	0,77	2,70	2,40	0,040	1	1	1	1	0,040	17,8	7,53	2,86	42%	3429	845
2	Gym Type 2	260	90	West	0,600	1,300	17-Gym cocle west	94ud Double glazing 4/16mm air/4	03ud Aluminium window frame, thermally	0,77	2,70	2,40	0,040	1	1	1	1	0,040	1,6	0,65	2,86	42%	300	78
6	Gym Type 3	180	90	South	0,600	0,900	20-Gym cocle south	94ud Double glazing 4/16mm air/4	03ud Aluminium window frame, thermally	0,77	2,70	2,40	0,040	1	1	1	1	0,040	3,2	1,19	2,87	37%	627	32
3	Gym Type 4	260	90	West	0,900	1,500	1-Gym west	94ud Double glazing 4/16mm air/4	03ud Aluminium window frame, thermally	0,77	2,70	2,40	0,040	1	1	1	1	0,040	4,1	2,27	2,82	56%	769	298
4	Gym Type 4	90	90	East	0,900	1,500	3-Gym east	94ud Double glazing 4/16mm air/4	03ud Aluminium window frame, thermally	0,77	2,70	2,40	0,040	1	1	1	1	0,040	5,4	3,03	2,82	56%	1026	372
6	Gym Type 4	180	90	South	0,900	1,500	4-Gym south	94ud Double glazing 4/16mm air/4	03ud Aluminium window frame, thermally	0,77	2,70	2,40	0,040	1	1	1	1	0,040	8,1	4,54	2,82	56%	1538	185
10	Gym Type 5 west	260	90	West	1,600	0,600	1-Gym west	94ud Double glazing 4/16mm air/4	03ud Aluminium window frame, thermally	0,77	2,70	2,40	0,040	1	1	0	1	0,040	9,6	4,22	2,79	44%	1801	379
10	Gym Type 5 west	260	90	West	0,800	1,400	1-Gym west	94ud Double glazing 4/16mm air/4	03ud Aluminium window frame, thermally	0,77	2,70	2,40	0,040	1	0	1	0	0,040	11,2	5,82	2,75	52%	2076	514
10	Gym Type 5 west	260	90	West	0,800	1,400	1-Gym west	94ud Double glazing 4/16mm air/4	03ud Aluminium window frame, thermally	0,77	2,70	2,40	0,040	0	1	1	0	0,040	11,2	5,82	2,75	52%	2076	514
10	Gym Type 5 east	90	90	East	1,600	0,600	3-Gym east	94ud Double glazing 4/16mm air/4	03ud Aluminium window frame, thermally	0,77	2,70	2,40	0,040	1	1	0	1	0,040	9,6	4,22	2,79	44%	1801	515
10	Gym Type 5 east	90	90	East	0,800	1,400	3-Gym east	94ud Double glazing 4/16mm air/4	03ud Aluminium window frame, thermally	0,77	2,70	2,40	0,040	1	0	1	0	0,040	11,2	5,82	2,75	52%	2076	698
10	Gym Type 5 east	90	90	East	0,800	1,400	3-Gym east	94ud Double glazing 4/16mm air/4	03ud Aluminium window frame, thermally	0,77	2,70	2,40	0,040	0	1	1	0	0,040	11,2	5,82	2,75	52%	2076	698
4	Type 6 west	260	90	West	0,900	1,500	21-Corridor cocle west	94ud Double glazing 4/16mm air/4	01ud Plastic window frame good	0,77	2,70	1,60	0,040	1	1	1	1	0,040	5,4	3,03	2,47	56%	898	241
4	Type 6 east	90	90	East	0,900	1,500	22-Corridor cocle east	94ud Double glazing 4/16mm air/4	01ud Plastic window frame good	0,77	2,70	1,60	0,040	1	1	1	1	0,040	5,4	3,03	2,47	56%	898	372
4	Type 7 west	260	90	West	1,200	2,600	5-Corridor west	94ud Double glazing 4/16mm air/4	01ud Plastic window frame good	0,77	2,70	1,60	0,040	1	1	1	1	0,040	12,5	8,54	2,53	68%	2130	695
3	Type 7 east	90	90	East	1,200	2,600	6-Corridor east	94ud Double glazing 4/16mm air/4	01ud Plastic window frame good	0,77	2,70	1,60	0,040	1	1	1	1	0,040	9,4	6,40	2,53	68%	1597	843
10	Gym Type 5 west	260	90	West	1,600	0,600	1-Gym west	94ud Double glazing 4/16mm air/4	03ud Aluminium window frame, thermally	0,77	2,70	2,40	0,040	1	1	0	1	0,040	9,6	4,22	2,79	44%	1801	395
10	Gym Type 5 west	260	90	West	0,800	1,400	1-Gym west	94ud Double glazing 4/16mm air/4	03ud Aluminium window frame, thermally	0,77	2,70	2,40	0,040	1	0	1	0	0,040	11,2	5,82	2,75	52%	2076	536
10	Gym Type 5 west	260	90	West	0,800	1,400	1-Gym west	94ud Double glazing 4/16mm air/4	03ud Aluminium window frame, thermally	0,77	2,70	2,40	0,040	0	1	1	0	0,040	11,2	5,82	2,75	52%	2076	536
10	Gym Type 5 east	90	90	East	1,600	0,600	3-Gym east	94ud Double glazing 4/16mm air/4	03ud Aluminium window frame, thermally	0,77	2,70	2,40	0,040	1	1	0	1	0,040	9,6	4,22	2,79	44%	1801	515
10	Gym Type 5 east	90	90	East	0,800	1,400	3-Gym east	94ud Double glazing 4/16mm air/4	03ud Aluminium window frame, thermally	0,77	2,70	2,40	0,040	1	0	1	0	0,040	11,2	5,82	2,75	52%	2076	698
10	Gym Type 5 east	90	90	East	0,800	1,400	3-Gym east	94ud Double glazing 4/16mm air/4	03ud Aluminium window frame, thermally	0,77	2,70	2,40	0,040	0	1	1	0	0,040	11,2	5,82	2,75	52%	2076	698
8	Gym Type 4	180	90	South	0,900	1,500	4-Gym south	94ud Double glazing 4/16mm air/4	03ud Aluminium window frame, thermally	0,77	2,70	2,40	0,040	1	1	1	1	0,040	10,8	6,05	2,82	56%	2051	213

					Window rough openings		installed in	Glazing	Frame	g-Value	U-Value		Ψ Glazing edge	Installation situation user-defined value for $\Psi_{installed}$ or '1': $\Psi_{installed}$ from worksheet 'Components' '0': in the case of abutting windows					Results U- and Ψ-values from 'Components' worksheet can be shown through clicking the '+' sign on the top edge of the sheet.					
Quantity	Description	Deviation from North	Angle of inclination from the horizontal	Orientation	Width	Height	Selection from worksheet 'Areas'	Selection from worksheet 'Components'	Selection from worksheet 'Components'	Perpen-dicular Radiation	Glazing	Frames (centre)	Ψ_{spacer} (centre)	left	right	bottom	above	$\Psi_{installation}$ (Average)	Window Area	Glazing Area	U-Value Window	Glazed fraction per window	Trans-mission-losses	Solar gains
		Degrees	Degrees		m	m		Sort: AS LIST	Sort: AS LIST	-	W/(m²K)	W/(m²K)	W/(mK)	W/(mK) or 1/0				W/(mK)	m²	m²	W/(m²K)	%	kWh/a	kWh/a

					Window rough openings		installed in	Glazing	Frame	g-Value	U-Value		Ψ Glazing edge	Installation situation user-defined value for $\Psi_{installed}$ or '1': $\Psi_{installed}$ from worksheet 'Components' '0': in the case of abutting windows					Results U- and Ψ-values from 'Components' worksheet can be shown through clicking the '+' sign on the top edge of the sheet.					
Quantity	Description	Deviation from North	Angle of inclination from the horizontal	Orientation	Width	Height	Selection from worksheet 'Areas'	Selection from worksheet 'Components'	Selection from worksheet 'Components'	Perpen-dicular Radiation	Glazing	Frames (centre)	Ψ_{spacer} (centre)	left	right	bottom	above	$\Psi_{Installation}$ (Average)	Window Area	Glazing Area	U-Value Window	Glazed fraction per window	Trans-mission-losses	Solar gains
		Degrees	Degrees		m	m		Sort: AS LIST	Sort: AS LIST	-	W/(m^{2}K)	W/(m^{2}K)	W/(mK)	W/(mK) or 1/0				W/(mK)	m^2	m^2	W/(m^{2}K)	%	kWh/a	kWh/a

CALCULATING SHADING FACTORS

Climate: User data - Велико Търново

Building: Primary School 8 "Sveti Sveti Kiril I Metodi" - Section C

Latitude: 43,086 °

Orientation	Glazing area	Reduction factor winter	Summer reduction factor
	m²	r_S	r_S
North	0,00	100%	100%
East	51,73	78%	55%
South	11,78	13%	28%
West	53,08	51%	28%
Horizontal	0,00	100%	100%

Space heating demand:	54,7	kWh/(m²a)
Useful Cooling Demand:	5,3	kWh/(m²a)
Frequency of overheating:	7,8%	

								Horizon		Reveal		Overhang					Winter				Summer			
Quantity	Description	Deviation from North	Angle of Inclination from the Horizontal	Orientation	Glazing width	Glazing height	Glazing area	Height of the shading object	Horizontal distance	Window reveal depth	Distance from glazing edge to reveal	Overhang depth	Distance from upper glazing edge to overhang	Additional reduction factor winter shading	Additional reduction factor summer shading	Reduction factor z for temporary sun protection	Horizontal shading reduction factor	Reveal Shading Reduction Factor	Overhang shading reduction factor	Total shading reduction factor	Horizontal Shading Reduction Factor	Reveal Shading Reduction Factor	Overhang shading reduction factor	Total shading reduction factor
		Degrees	Degrees		m	m		m	m	m	m	m	m	%	%	%	%	%	%	%	%	%	%	%
					w_O	h_O	A_O	h_{Hori}	d_{Hori}	o_{Reveal}	d_{Reveal}	o_{over}	d_{over}	$r_{other,w}$	$r_{other,s}$	z	r_H	r_R	r_O	r_S	r_H	r_R	r_O	r_S
20	Gym Type 1	260	90	West	0,32	1,07	6,8	22,40	44,00	0,20	0,140	0,15	0,14	95%	70%	60%	65%	77%	94%	45%	72%	91%	98%	27%
22	Gym Type 1	90	90	East	0,32	1,07	7,5			0,20	0,140	0,15	0,14			60%	100%	77%	94%	72%	100%	91%	98%	54%
2	Gym Type 2	260	90	West	0,32	1,02	0,7			0,20	0,140	0,15	0,14	95%	70%	60%	100%	77%	94%	68%	100%	91%	98%	37%
6	Gym Type 3	180	90	South	0,32	0,62	1,2	15,75	6,00	0,20	0,140	0,15	0,14			60%	12%	85%	94%	10%	51%	81%	87%	21%
3	Gym Type 4	260	90	West	0,62	1,22	2,3			0,20	0,140	0,15	0,14	95%	70%	60%	100%	84%	94%	75%	100%	94%	98%	39%
4	Gym Type 4	90	90	East	0,62	1,22	3,0			0,20	0,140	0,15	0,14			60%	100%	84%	94%	79%	100%	94%	98%	55%
6	Gym Type 4	180	90	South	0,62	1,22	4,5	11,53	6,00	0,20	0,140	0,15	0,14			60%	17%	90%	96%	15%	60%	87%	95%	29%
10	Gym Type 5 wes	260	90	West	1,32	0,32	4,2	19,60	44,00	0,20	0,140	0,15	0,14	95%	70%	60%	69%	90%	87%	51%	75%	96%	90%	27%
10	Gym Type 5 wes	260	90	West	0,52	1,12	5,8	19,60	44,00	0,20	0,140	0,15	0,14	95%	70%	60%	69%	82%	94%	50%	75%	93%	98%	29%
10	Gym Type 5 wes	260	90	West	0,52	1,12	5,8	19,60	44,00	0,20	0,140	0,15	0,14	95%	70%	60%	69%	82%	94%	50%	75%	93%	98%	29%
10	Gym Type 5 eas	90	90	East	1,32	0,32	4,2			0,20	0,140	0,15	0,14			60%	100%	90%	87%	78%	100%	97%	91%	53%
10	Gym Type 5 eas	90	90	East	0,52	1,12	5,8			0,20	0,140	0,15	0,14			60%	100%	82%	94%	77%	100%	93%	98%	55%
10	Gym Type 5 eas	90	90	East	0,52	1,12	5,8			0,20	0,140	0,15	0,14			60%	100%	82%	94%	77%	100%	93%	98%	55%
4	Type 6 west	260	90	West	0,62	1,22	3,0	19,85	44,00	0,20	0,140	0,15	0,14	84%	62%	60%	69%	84%	94%	46%	75%	94%	98%	26%
4	Type 6 east	90	90	East	0,62	1,22	3,0			0,20	0,140	0,15	0,14			60%	100%	84%	94%	79%	100%	94%	98%	55%
4	Type 7 west	260	90	West	0,92	2,32	8,5	22,40	44,00	0,20	0,140	0,15	0,14	84%	62%	60%	65%	88%	97%	47%	72%	95%	99%	25%
3	Type 7 east	90	90	East	0,92	2,32	6,4			0,20	0,140	0,15	0,14			60%	100%	87%	97%	84%	100%	95%	99%	57%
10	Gym Type 5 wes	260	90	West	1,32	0,32	4,2	17,30	44,00	0,20	0,140	0,15	0,14	95%	70%	60%	72%	90%	87%	53%	77%	96%	90%	28%
10	Gym Type 5 wes	260	90	West	0,52	1,12	5,8	17,30	44,00	0,20	0,140	0,15	0,14	95%	70%	60%	72%	82%	94%	53%	77%	93%	98%	30%
10	Gym Type 5 wes	260	90	West	0,52	1,12	5,8	17,30	44,00	0,20	0,140	0,15	0,14	95%	70%	60%	72%	82%	94%	53%	77%	93%	98%	30%
10	Gym Type 5 eas	90	90	East	1,32	0,32	4,2			0,20	0,140	0,15	0,14			60%	100%	90%	87%	78%	100%	97%	91%	53%
10	Gym Type 5 eas	90	90	East	0,52	1,12	5,8			0,20	0,140	0,15	0,14			60%	100%	82%	94%	77%	100%	93%	98%	55%
10	Gym Type 5 eas	90	90	East	0,52	1,12	5,8			0,20	0,140	0,15	0,14			60%	100%	82%	94%	77%	100%	93%	98%	55%
8	Gym Type 4	180	90	South	0,62	1,22	6,1	13,13	6,00	0,20	0,140	0,15	0,14			60%	15%	90%	96%	13%	56%	87%	95%	28%

Quantity	Description	Deviation from North	Angle of Inclination from the Horizontal	Orientation	Glazing width	Glazing height	Glazing area	Height of the shading object	Horizontal distance	Window reveal depth	Distance from glazing edge to reveal	Overhang depth	Distance from upper glazing edge to overhang	Additional reduction factor winter shading	Additional reduction factor summer shading	Reduction factor z for temporary sun protection	Horizontal shading reduction factor	Reveal Shading Reduction Factor	Overhang shading reduction factor	Total shading reduction factor	Horizontal Shading Reduction Factor	Reveal Shading Reduction Factor	Overhang shading reduction factor	Total shading reduction factor
		Degrees	Degrees		m	m		m	m	m	m	m	m	%	%	%	%	%	%	%	%	%	%	%
					w_G	h_G	A_G	h_{Hori}	d_{Hori}	o_{Reveal}	d_{Reveal}	o_{over}	d_{over}	$r_{other,w}$	$r_{other,s}$	z	r_H	r_R	r_O	r_S	r_H	r_R	r_O	r_S

EnerPHit planning: # VENTILATION DATA

Building: Primary School 8 "Sveti Sveti Kiril I Metodi" - Section C

Treated floor area A_{TFA}		m²	719	*(Areas worksheet)*
Room Height h		m	2,50	
Room ventilation volume (A_{TFA}*h) =	V_V	m³	1798	*(Worksheet Annual heating)*

Ventilation type

Please select: **Balanced PH-Ventilation with HR**

Infiltration air change rate

Wind protection coefficients e and f	Several side exposed	One side exposed
Coefficient e for screening class		
No screening	0,10	0,03
Moderate screening	0,07	0,02
High screening	0,04	0,01
Coefficient f	15	20

			for annual demand:	for Heating Load:				
Wind protection coefficient, e			0,07	0,18				
Wind protection coefficient, f			15	15	Net Air Volume for Press. Test	V_{n50}	Air permeability	q_{50}
Air Change Rate at Press. Test	n_{50}	1/h	2,00	2,00	3439	m³	3,85	m³/(hm²)

			for annual demand:	for Heating Load:
Excess extract air		1/h	0,00	0,00
Infiltration air change rate	$n_{V,Rest}$	1/h	0,268	0,669

Selection of ventilation data input - Results

The PHPP offers two methods for dimensioning the air quantities and choosing the ventilation unit. Fresh air or extract air quantities for residential buildings and parameters for ventilation system can be determined using the standard planning option in the 'Ventilation' sheet. The 'Additional Vent' sheet has been created for more complex ventilation systems and allows up to 10 different ve Furthermore, air quantities can be determined on a room-by-room or zone-by-zone basis. Please select your design method here.

	Ventilation unit / Heat recovery efficiency design		Average Air Exchange m³/h	Average Air Change Rate 1/h	Extract air excess (Extract air system) 1/h	Effective heat recovery efficiency Unit [-]	Energy recovery value [-]	Specific power input Wh/m³	Heat recovery efficiency SHX [-]
	Standard design	*(Ventilation worksheet see below)*							
x	Various vent. units, non residential	*(Worksheet Additional vent)*	756	0,42	0,00	81,1%	0,0%	0,40	0,0%

SHX efficiency η^*_{SHX}: 0%

STANDARD INPUT FOR BALANCED VENTILATION

Ventilation dimensioning for systems with one ventilation unit

Calculation in sheet 'Additional Vent': Extended data input for balanced ventilation

Occupancy	m²/P	12				
Number of occupants	P	60,0				
Supply air per person	m³/(P*h)	60				
Supply air requirement	m³/h	3600				
Extract air rooms		Kitchen	Bathroom	Bathroom (shower only)	WC	
Quantity						
Extract air requirement per room	m³/h	60	40	20	20	
Total Extract Air Requirement	m³/h	0				

Design air flow rate (maximum) m³/h **6600**

Average air change rate calculation

Type of operation	Daily operation duration h/d	Factors referenced to maximum	Air flow rate m³/h	Air change rate 1/h
maximum		1,00	6600	3,67
Standard	4,0	0,77	5077	2,82
Basic	6,0	0,54	3554	1,98
Minimum	14,0	0,40	2640	1,47
		Average value	0,50	Average air flow rate (m³/h)	Average air change rate (1/h)

Selection of ventilation unit with heat recovery

Installation site of ventilation unit: Inside the thermal envelope

	Sort: BY ID	Heat recovery efficiency Unit η_{HR}	Energy recovery η_{ERV}	Specific power input [Wh/m³]	Application range [m³/h]	Frost required
Ventilation unit selection	0468v103 ComfoAir XL4400 - Zehnder	0,84	0,00	0,42	1500 - 3200	yes

Go to ventilation units list

Conductance value of exterior air duct	Ψ	W/(mK)		See calculation below
Length of exterior air duct		m	2	
Conductance value of exhaust air duct	Ψ	W/(mK)		See calculation below
Length of exhaust air duct		m	2	
Temperature of mechanical services room (Enter only if the central unit is outside of the thermal envelope.)		°C	20	

Room temperature (°C) 18
Av. Ambient Temp. Heating P. (°C) 4,5
Av. Ground Temp (°C) 11,4

Effective heat recovery efficiency $\eta_{HR,eff}$

Effective heat recovery efficiency subsoil heat exchanger

SHX efficiency	η^*_{SHX}	
Heat recovery efficiency SHX	η_{SHX}	0%

Secondary calculation

Ψ-value supply or ambient air duct

Nominal width:	60	mm
Insul. Thickness	80	mm
Reflective?		Yes
	x	No
Thermal conductivity	0,033	W/(mK)
Nominal air flow rate		m³/h
Δϑ	13	K
Exterior duct diameter	0,060	m
Exterior diameter	0,220	m
α-Interior	#WERT!	W/(m²K)
α–Surface		W/(m²K)
Ψ-value		**W/(mK)**
Surface temperature difference		K

Secondary calculation

Ψ-value extract or exhaust air duct

Nominal width:	60	mm
Insul. Thickness:	80	mm
Reflective?		yes
	x	no
Thermal conductivity	0,033	W/(mK)
Nominal air flow rate		m³/h
Δϑ	13	K
Exterior duct diameter	0,060	m
Exterior diameter	0,220	m
α-Interior	#WERT!	W/(m²K)
α–Surface		W/(m²K)
Ψ-value		**W/(mK)**
Surface temperature difference		K

EnerPHit planning: # EXTENDED DATA INPUT FOR BALANCED VENTILATION

Planning ventilation systems with multiple ventilation units

Building: Primary School 8 "Sveti Sveti Kiril I Metodi" - Section C

Ventilation unit / Heat recovery efficiency design

In Ventilation worksheet (standard design)			*(Ventilation worksheet)*
In Additional Vent (this worksheet)		x	*(Additional vent)*
Treated Floor Area A_{TFA}	m²	719	*(Areas worksheet)*
Room Height h	m	2,50	*(Worksheet Annual heating)*
Room air volume for ventilation (A_{TFA}*h) = V_v	m³	1798	*(Worksheet Annual heating)*
Number of Occupants	P	60,0	*(Ventilation worksheet)*
Room temperature	°C	18	*(Worksheet Annual heating)*
Average external temp. heating period	°C	4,5	*(Ventilation worksheet)*
Average ground temp.	°C	11,4	*(Ground worksheet)*
Ventilation type		Balanced PH-Ventilation with HR	*(Ventilation worksheet)*

Results of ventilation design and unit selection:

Venti-lation Unit no.	Description of the unit	Design V_{SUP} m³/h	Design V_{ETA} m³/h	Average value / yr. V_{SUP} m³/h	Average value / yr. V_{ETA} m³/h	Average value / yr. Air ch.rt. 1/h	Effective heat recovery efficiency	Energy recovery value	spec. Input power	Heat recov. efficiency SHX	Cross check
1	Floor -1	300	300	42	42	---	78%	0%	0,40	0%	
2	Gym F-1	1000	1000	144	144	---	80%	0%	0,40	0%	
3	Floor 1	550	550	167	167	---	81%	0%	0,40	0%	
4	Gym F 1	1200	1200	404	404	---	82%	0%	0,40	0%	
5						---					
6						---					
7						---					
8						---					
9						---					
10						---					
Result for overall vent. syst.		**3050**	**3050**	**756**	**756**	**0,42**	**81%**	**0%**	**0,40**	**0%**	

Recommendations for dimensioning air quantities

Use of low odour and low-emission building materials/ furnishings:
It is strongly recommended to use building materials that cause no or only little pollution instead of increasing the outdoor air volume flow in order to reduce preventable pollution.
This holds true independently from the chosen approach for the air quality determination; emissions of all sources in the room should be considered, e.g. furniture, carpets and ventilation or air-conditioning unit.

Assessment of volume flow rates according to the number of persons
Also in non-residential buildings, the number of persons is fundamentally important for assessing the volume air flow rates. For good indoor air quality the amounts of 20 to 30 m³/h/person are completely sufficient.
Higher outdoor air amounts may lead to excessively dry indoor air in winter. The air flow rates are specified by classification according to EN 13779. The classification must be agreed with the client in advance.
IDA 3 is adequate for office buildings. IDA 4 has proven satisfactory for school buildings as purge ventilation is carried out during breaks anyway. For typical external air CO_2 concentrations of around 400-500 ppm, it is possible to comply even with 1500 ppm. Exceeding this figure temporarily is permissible.

Fresh air flow rates per person:
- Recommended for residential buildings: around 30 m³/(h person)
- Recommended for offices and similar uses: around 30 m³/(h person) (AMEV: 28 m³/(h person); EN 13779 / IDA 3: at least 24 m³/(h person))
- Recommended for schools and day care centres: 15 to 20 m³/(h person) (Source: Guidelines for energy-efficient educational buildings, Passive House Institute, 2010)
- Recommendation for sport halls: 60 m³/(h person) (DIN 18032-1)

Purging phase for intermittent ventilation operation
Due to the purge ventilation phase, the ventilation operation period is extended accordingly (utilisation time + purge ventilation phase). Please consider this for the ventilation design.
Emissions have to be removed. Flushing the building prolongs the utilization time of the ventilation system (utilization time + flushing phase). Please consider this at design stage.

Design of air quantities

When designing the air quantities, please consider the design recommendations given above.
The ventilation operation period can be determined on the basis of the daily utilisation hours including purging phase if applicable. In addition, time periods with reduced ventilation requirements (operation modes) can be
Taken into account by means of reduction factors.

Room Nr.	Amount a	Room name	Asignment to ventilation unit	Area A m²	Clear height h m	Room vol. A x h m³	Volume flow per room V_{SUP} m³/h	V_{ETA} m³/h	V_{TRANS} m³/h	Air change rate per room n 1/h	Utilisation times h/d h	d/week d	weeks/yr Weeks	Reduction Red.1	Operation Red. 1	Reduction Red.2	Operation Red.2	Reduction Red.3	Operation Red. 3	Cross check	Average volume flows V_{SUP} m³/h	V_{ETA} m³/h	V_{TRANS} m³/h	Average air change rate 1/h
1	1	Entrance	1	14,8	3,00	44	50		100	2,26	14	5	32	100%	0%	60%	70%	40%	30%		7		14	0,31
2	1	Antechamber	1	16,0	3,00	48	125		100	2,61	14	5	32	100%	0%	60%	70%	40%	30%		17		14	0,36
3	1	Changing-room	1	10,3	3,00	31	125			4,05	14	5	32	100%	0%	60%	70%	40%	30%		17			0,56
4	1	WC	1	9,8	3,00	29		150		5,10	14	5	32	100%	0%	60%	70%	40%	30%			21		0,71
5	1	Walkway	1	19,8	3,00	59		150		2,53	14	5	32	100%	0%	60%	70%	40%	30%			21		0,35
6	1	Gym 1 - UG	2	271,4	4,90	1330	1000	1000		0,75	14	5	32	100%	0%	60%	80%	40%	20%		144	144		0,11
7	1	Entrance	3	14,1	3,30	47	50		100	2,14	14	7	50	100%	0%	60%	70%	40%	30%		15		30	0,65
8	1	Changing-room	3	16,4	3,30	54	200			3,70	14	7	50	100%	0%	60%	70%	40%	30%		61			1,12
9	1	WC	3	10,8	3,30	36		100		2,81	14	7	50	100%	0%	60%	70%	40%	30%			30		0,85
10	1	Walkway	3	21,2	3,30	70		150		2,15	14	7	50	100%	0%	60%	70%	40%	30%			45		0,65
11	1	Corridor	3	9,2	3,30	30		100		3,28	14	7	50	100%	0%	60%	70%	40%	30%			30		0,99
12	1	Changing-room	3	12,6	3,30	41	150			3,62	14	7	50	100%	0%	60%	70%	40%	30%		45			1,10
13	1	Changing-room	3	11,0	3,30	36	150			4,15	14	7	50	100%	0%	60%	70%	40%	30%		45			1,26
14	1	WC	3	10,8	3,30	36		100		2,81	14	7	50	100%	0%	60%	70%	40%	30%			30		0,85
15	1	Others	3	8,8	3,30	29		100		3,45	14	7	50	100%	0%	60%	70%	40%	30%			30		1,04
16	1	Gym	4	280,3	5,30	1485	1150	1200		0,81	14	7	50	100%	20%	60%	40%	40%	40%		387	404		0,27
17	1	Teachers room	4	10,7	3,30	35	50			1,42	14	7	50	100%	20%	60%	40%	40%	40%		17			0,48
18														100%	100%									
19														100%	100%									
20														100%	100%									
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		Additional lines: Please mark complete lines above, copy and paste multiple times																			756	756	---	0,22

Ventilation unit selection

Up to 10 different ventilation units are considered. By changing the amount, identical units can be considered. The data from PHI certified ventilation units
as well as the entry data lines for user data for other ventilation units can also be found in the worksheet "Components". When choosing to use a compact unit the standard design in the Ventilation worksheet has to be used.

Go to ventilation units list

Venti-lation Unit no.	Quan-tity [-]	Description Ventilation units	Selection Unit type	Design vol. flow per unit m³/h	Entry area for volume flow rate from m³/h	to m³/h	Electrical efficiency Wh/m³	Pressure loss calculation ODA-SUP Δp_{duct} Pa	ETA-EHA Δp_{duct} Pa	Additional Δp_{intern} Pa	Entry area per line $\Delta p_{external}$ Pa	Subtraction Δp_{intern} Pa	Cross check ---------- Pressure loss assessment duct network	Interior location (x)	Exterior location (x)	Heat recovery efficiency Unit [-]	effective [-]	Energy recovery value [-]	Frost protection necessary	Subsoil HX Effective-efficiency degree	Efficiency of heat recovery	Noise protecti U noise level < 35dB(A)	adapter Supply air db(A)
1	1	Floor -1	03ud Tangra ventilation unit EVB 04 Hi	300	100	400	0,40	55	55		100	-	ok	x		0,82	78%	0%	yes		0%	n.a.	61
2	1	Gym F-1	05ud Tangra ventilation unit EVB 16 Hi	1000	400	1600	0,40	20	20	80	100	-	ok	x		0,82	80%	0%	yes		0%	n.a.	n.a.
3	1	Floor 1	02ud Tangra ventilation unit EVB 06 Hi	550	200	600	0,40	55	55		100	-	ok	x		0,82	81%	0%	yes		0%	n.a.	57
4	1	Gym F 1	05ud Tangra ventilation unit EVB 16 Hi	1200	400	1600	0,40	20	20	80	100	-	ok	x		0,82	82%	0%	yes		0%	n.a.	n.a.
5																							
6																							
7																							
8																							
9																							
10																							

Data entries for duct sections between the ventilation unit and the thermal envelope

The duct sections between the ventilation unit and the thermal envelope should be as short as possible and should be well insulated, both for interior as for exterior location of the ventilation unit. These duct sections can be entered here. The heat losses of the overlying duct section will be considered for the effective heat recovery efficiency.
An entered duct section can also be used for multiple ventilation units.
If in the section "Ventilation unit - selection" in one line a ventilation unit is selected as multiple units (amount larger than 1 for identical units), then the corresponding duct sections may simply be entered (duct sections for one ventilation unit).

Temperature of the location of installation: 11,0 (only enter when at least one unit is installed outside of the thermal envelope)

Quan-tity	Cross check	Round duct ins. diameter mm	Rectangular duct Width mm	Height mm	Insulation Thickness mm	Thermal conducti-vity W/(m K)	Reflective insulation duct (x)	Transmittance duct W/(m K)	Length of Supply air m	Ambient or Extract air Duct (1)	Exhaust or flow Duct (1)	Duct type	Design Volume rate	Allocation to ventilation units (when central unit applicable enter "1") Vent. Unit 1	Vent. Unit 2	Vent. Unit 3	Vent. Unit 4	Vent. Unit 5	Vent. Unit 6	Vent. Unit 7	Vent. Unit 8	Vent. Unit 9	Vent. Unit 10
1		160			150	0,033		0,185	3	1		Supply air	300	1									
1		160			100	0,033		0,234	10		1	Abluft	300	1									
1		315			150	0,033		0,290	3	1		Ambient air	1000		1								
1		315			150	0,033		0,290	10		1	Fortluft	1000		1								
1		160			150	0,033		0,187	3	1		Ambient air	550			1							
1		160			100	0,033		0,239	2		1	Fortluft	550			1							
1		315			150	0,033		0,292	3	1		Ambient air	1200				1						
1		315			150	0,033		0,292	2		1	Fortluft	1200				1						
													0										
													0										
													0										
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Additional lines: Please mark complete lines above, copy and paste multiple times

EnerPHit planning: # SPECIFIC ANNUAL HEATING DEMAND (annual method)

Climate: User data - Велико Търнов
Building: Primary School 8 "Sveti Sveti Kiril I Metodi" - Section C

Interior Temperature: 18,0 °C
Building type: School
Treated Floor Area A_{TFA}: 719,4 m²

Building assembly	Temperature Zone	Area m²		U-Value W/(m²K)		Temp. Factor f_t		G_t kKh/a		kWh/a	per m² Treated Floor Area kWh/(m²a)
Exterior Wall - Ambient	A	518,5	*	0,141	*	1,00	*	67,4	=	4910	6,83
Exterior Wall - Ground	B	235,9	*	0,271	*	0,41	*	67,4	=	1773	2,46
Roof/Ceiling - Ambient	A	400,3	*	0,113	*	1,00	*	67,4	=	3041	4,23
Floor slab / basement ceiling	B	400,3	*	0,302	*	0,41	*	67,4	=	3356	4,66
Floor over unheated basement	B		*		*	0,41	*		=		
	A		*		*	1,00	*		=		
	X		*		*	0,75	*		=		
Windows	A	227,8	*	2,749	*	1,00	*	67,4	=	42195	58,65
Exterior Door	A	2,5	*	2,250	*	1,00	*	67,4	=	383	0,53
Exterior TB (length/m)	A	164,6	*	0,087	*	1,00	*	67,4	=	966	1,34
Perimeter TB (length/m)	P	59,1	*	-0,028	*	0,41	*	67,4	=	-46	-0,06
Ground TB (length/m)	B		*		*	0,41	*		=		0,00
Total of all building envelope areas		1785,4									kWh/(m²a)
Transmission heat losses Q_T									Total	56578	78,6

Ventilation System:

		A_{TFA} m²		Clear Room Height m		m³
Effective Air Volume, V_V		719,4	*	2,50	=	1798,5

Effective heat recovery efficiency of heat recovery: η_{eff} 81%
Efficiency of Subsoil Heat Exchanger: η_{SHX} 0%

	$n_{V,system}$ 1/h		η_{HR}		$n_{V,Res}$ 1/h		1/h
Energetically Effective Air Exchange n_v	0,420	* (1 -	0,81	) +	0,268	=	0,347

	V_V m³		n_V 1/h		c_{Air} Wh/(m³K)		G_t kKh/a		kWh/a	kWh/(m²a)
Ventilation heat losses Q_V	1798,5	*	0,347	*	0,33	*	67,4	=	13882	19,3

	Q_T kWh/a		Q_V kWh/a		Reduction Factor Night/Weekend Saving	kWh/a	kWh/(m²a)
Total heat losses Q_L	(56578	+	13882	)	1,0	= 70460	97,9

Orientation of the area	Reduction Factor See 'Windows' worksheet		g-Value (perp. radiation)		Area m²		Radiation HP kWh/(m²a)		kWh/a
1. North	0,00	*	0,00	*	0,00	*	127	=	0
2. East	0,32	*	0,77	*	101,98	*	251	=	6254
3. South	0,06	*	0,77	*	22,14	*	444	=	430
4. West	0,21	*	0,77	*	103,69	*	281	=	4723
5. Horizontal	0,00	*	0,00	*	0,00	*	417	=	0
Available Solar Heat Gains Q_S								Total	11407	kWh/(m²a) 15,9

	kh/d	Length heating period d/a		Spec. Power q_i W/m²		A_{TFA} m²		kWh/a	kWh/(m²a)
Internal Heat Gains Q_I	0,024	* 194	*	5,43	*	719,4	=	18185	25,3

		kWh/a	kWh/(m²a)
Free Heat Q_F	$Q_S + Q_I$ =	29592	41,1
Ratio of Free Heat to Losses	Q_F / Q_L =	0,42	
Utilisation Factor Heat Gains η_G	$(1 - (Q_F/Q_L)^5) / (1 - (Q_F/Q_L)^6)$ =	99%	
Heat Gains Q_G	$\eta_G * Q_F$ =	29366	40,8

		kWh/a	kWh/(m²a)
Annual heating demand QH	$Q_L - Q_G$ =	41094	57

	kWh/(m²a)	(Yes/No)
Limiting value	25	**Requirement met?** no

EnerPHit planning: **SPECIFIC ANNUAL HEATING DEMAND (monthly method)**

(This page displays the sums of the monthly method over the heating period)

Climate: Велико Търново | Interior Temperature: 18 °C

Building: primary School 8 "Sveti Sveti Kiril I Metodi" - Section C | Building type: School

Spec. Capacity: 204 Wh/(m²K) | Treated Floor Area A_{TFA}: 719,4 m²

Building assembly	Temperature Zone	Area m²		U-Value W/(m²K)		Month. Red. Fac.		G_t kKh/a		kWh/a	per m² Treated Floor Area
Exterior Wall - Ambient	A	518,5	*	0,141	*	1,00	*	69	=	5058	7,03
Exterior Wall - Ground	B	235,9	*	0,271	*	1,00	*	29	=	1878	2,61
Roof/Ceiling - Ambient	A	400,3	*	0,113	*	1,00	*	69	=	3133	4,35
Floor slab / basement ceiling	B	400,3	*	0,302	*	1,00	*	29	=	3556	4,94
Floor over unheated basement	B		*		*	1,00	*		=		
	A		*		*	1,00	*		=		
	X		*		*	0,75	*		=		
Windows	A	227,8	*	2,749	*	1,00	*	69	=	43465	60,42
Exterior Door	A	2,5	*	2,250	*	1,00	*	69	=	395	0,55
Exterior TB (length/m)	A	164,6	*	0,087	*	1,00	*	69	=	995	1,38
Perimeter TB (length/m)	P	59,1	*	-0,028	*	1,00	*	29	=	-49	-0,07
Ground TB (length/m)	B		*		*	1,00	*		=		0,00

Transmission heat losses Q_T — Total: 58431 kWh/a | 81,2 kWh/(m²a)

Effective Air Volume V_V: A_{TFA} 719 m² * Clear Room Height 2,50 m = 1798 m³

	$n_{V,system}$ 1/h		η^*_{SHX}		η_{HR}		$n_{V,Res}$ 1/h		$n_{V,equi,fraction}$ 1/h
Effective Air Change Rate Ambient $n_{V,a}$	0,420	*(1-	0%	)*(1-	0,81	)+	0,268	=	0,347
Effective Air Change Rate Ground $n_{V,g}$	0,420	*	0%	*(1-	0,81	)		=	0,000

	V_V m³		$n_{V,equi,fraction}$ 1/h		c_{Air} Wh/(m³K)		G_t kKh/a		kWh/a	kWh/(m²a)
Ventilation losses ambient Q_V	1798	*	0,347	*	0,33	*	69	=	14300	19,9
Ventilation losses ground $Q_{V,e}$	1798	*	0,000	*	0,33	*	33	=	0	0,0

Ventilation heat losses Q_V — Total: 14300 kWh/a | 19,9 kWh/(m²a)

Total heat losses Q_L = (Q_T 58431 kWh/a + Q_V 14300 kWh/a) * Reduction Factor Night/Weekend Saving 1,0 = 72731 kWh/a | 101,1 kWh/(m²a)

Orientation of the area	Reduction Factor See 'Windows' worksheet		g-Value (perp. radiation)		Area m²		Global Radiation kWh/(m²a)		kWh/a
North	0,00	*	0,00	*	0,0	*	150	=	0
East	0,32	*	0,77	*	102,0	*	300	=	7485
South	0,06	*	0,77	*	22,1	*	517	=	502
West	0,21	*	0,77	*	103,7	*	335	=	5624
Horizontal	0,00	*	0,00	*	0,0	*	500	=	0
Sum opaque areas									1045

Available Solar Heat Gains Q_S — Total: 14655 kWh/a | 20,4 kWh/(m²a)

	kh/d		Length Heat. Period d/a		Spec. Power q_i W/m²		A_{TFA} m²		kWh/a	kWh/(m²a)
Internal Heat Gains Q_I	0,024	*	212	*	5,4	*	719,4	=	19875	27,6

		kWh/a	kWh/(m²a)
Free Heat Q_F	Q_S + Q_I =	34530	48,0
Ratio Free Heat to Losses	Q_F / Q_L =	0,47	
Utilisation Factor Heat Gains η_G	=	97%	
Heat Gains Q_G	η_G * Q_F =	33402	46,4
Annual heating demand QH	Q_L - Q_G =	39328	**55**

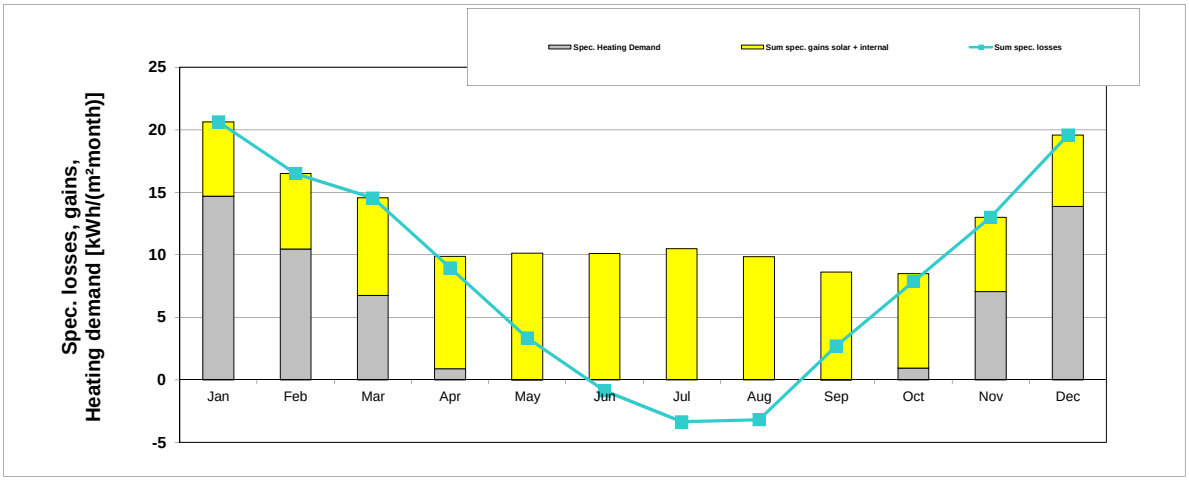
Limiting value 25 kWh/(m²a) — Requirement met? (Yes/No): **no**

EnerPHit planning: **SPECIFIC ANNUAL HEATING DEMAND (monthly method)**

Climate: Велико Търнов
Building: Primary School 8 "Sveti Sveti Kiril I Metodi" - Section C

Interior Temperature: 18 °C
Building type: School
Treated Floor Area A_{TFA}: 719 m²

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Heating Degree Hours - Exterior	14,3	11,3	9,7	5,7	1,8	-0,9	-2,6	-2,3	1,8	5,5	9,1	13,7	67	kKh
Heating Degree Hours - Ground	5,1	5,1	5,6	4,7	3,8	1,3	0,3	-0,2	1,2	1,9	2,9	4,1	36	kKh
Losses - Exterior	13911	10941	9449	5580	1715	-860	-2475	-2256	1719	5309	8833	13323	65189	kWh
Losses - Ground	937	931	1016	866	701	230	59	-35	222	350	527	759	6563	kWh
Sum spec. losses	20,6	16,5	14,5	9,0	3,4	-0,9	-3,4	-3,2	2,7	7,9	13,0	19,6	99,7	kWh/m²
Solar gains - North	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh
Solar gains - East	699	873	1372	1996	2420	2495	2570	2221	1746	1247	699	599	18937	kWh
Solar gains - South	59	66	82	87	83	79	84	90	93	88	63	55	931	kWh
Solar gains - West	527	664	1057	1314	1555	1538	1634	1556	1299	1007	599	456	13205	kWh
Solar gains - Horiz.	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh
Solar gains - Opaque	92	124	196	271	330	340	356	317	247	177	103	81	2634	kWh
Internal Heat Gains	2906	2625	2906	2813	2906	2813	2906	2906	2813	2906	2813	2906	34219	kWh
Sum spec. gains solar + internal	6,0	6,0	7,8	9,0	10,1	10,1	10,5	9,9	8,6	7,5	5,9	5,7	97,2	kWh/m²
Utilisation Factor	100%	100%	100%	90%	33%	100%	100%	100%	31%	92%	100%	100%	46%	
Annual heating demand	10564	7520	4860	632	0	0	0	0	0	682	5086	9984	39328	kWh
Spec. Heating Demand	**14,7**	**10,5**	**6,8**	**0,9**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,9**	**7,1**	**13,9**	**54,7**	kWh/m²



Annual heating demand: Comparison

Monthly method	*(Worksheet Heat*	**39328**	**kWh/a**	**54,7**	**kWh/(m²a) reference to treated floor area according to PHPP**
Annual method	*(Worksheet Annu*	**41094**	**kWh/a**	**57,1**	**kWh/(m²a) reference to treated floor area according to PHPP**

EnerPHit planning: # SPECIFIC SPACE HEATING LOAD

Building: primary School 8 "Sveti Sveti Kiril I Metodi" - Section C — Building type: School

Climate (HL): Велико Търнов — Treated Floor Area A_{TFA}: 719,4 m² — Interior Temperature: 18 °C

	Design Temperature		Radiation:	North	East	South	West	Horizontal	
Weather 1:	-9,3	°C		19	39	82	35	56	W/m²
Weather 2:	-4,8	°C		16	23	40	24	36	W/m²
Ground Design Temp.	10,4	°C							

	Building assembly	Temperature Zone	Area m²		U-Value W/(m²K)		Factor Always 1 (except "X")		TempDiff 1 K		TempDiff 2 K		P_T 1 W		P_T 2 W
1.	Exterior Wall - Ambient	A	518,5	*	0,141	*	1,00	*	27,3	or	22,8	=	1992	or	1664
2.	Exterior Wall - Ground	B	235,9	*	0,271	*	1,00	*	7,6	or	7,6	=	483	or	483
3.	Roof/Ceiling - Ambient	A	400,3	*	0,113	*	1,00	*	27,3	or	22,8	=	1234	or	1031
4.	Floor slab / basement ceiling	B	400,3	*	0,302	*	1,00	*	7,6	or	7,6	=	915	or	915
5.	Floor over unheated basement	B		*		*	1,00	*	7,6	or	7,6	=		or	
6.		A		*		*	1,00	*	27,3	or	22,8	=		or	
7.		X		*		*	0,75	*	27,3	or	22,8	=		or	
8.	Windows	A	227,8	*	2,749	*	1,00	*	27,3	or	22,8	=	17121	or	14302
9.	Exterior Door	A	2,5	*	2,250	*	1,00	*	27,3	or	22,8	=	156	or	130
10.	Exterior TB (length/m)	A	164,6	*	0,087	*	1,00	*	27,3	or	22,8	=	392	or	328
11.	Perimeter TB (length/m)	P	59,1	*	-0,028	*	1,00	*	7,6	or	7,6	=	-13	or	-13
12.	Ground TB (length/m)	B		*		*	1,00	*	7,6	or	7,6	=		or	
13.	House/DU Partition Wall	I	28,6	*	0,782	*	1,00	*	1,0	or	1,0	=	22	or	22

Transmission heat load P_T

Total = 22303 or 18863

Ventilation System:

Effective Air Volume, V_v: A_{TFA} 719,4 m² * Clear Room Height 2,50 m = 1798 m³

Heat recovery efficiency of the Heat Exchanger η_{HR} 81% — Heat Recovery Efficiency SHX 0% — Efficiency SHX: η_{SHX} 1 0% or η_{SHX} 2 0%

Energetically Effective Air Exchange n_v: $n_{V,Res}$ (Heating Load) 0,669 1/h + $n_{V,system}$ 0,420 1/h *(1- Φ_{HR} 0,81 or Φ_{HR} 0,81) = 0,749 1/h or 0,749 1/h

Ventilation heat load P_v

V_v m³		n_v 1/h		n_v 1/h	c_{Air} Wh/(m³K)		TempDiff 1 K		TempDiff 2 K		P_V 1 W		P_V 2 W
1798,5	*	0,749	or	0,749	* 0,33	*	27,3	or	22,8	=	12146	or	10147

Total heating load P_L

$P_T + P_V$ = P_L 1 34449 W or P_L 2 29010 W

	Orientation of the area	Area m²		g-Value (perp. radiation)		Reduction Factor (see 'Windows' worksheet)		Radiation 1 W/m²		Radiation 2 W/m²		P_T 1 W		P_T 2 W
1.	North	0,0	*	0,0	*	0,40	*	19	or	16	=	0	or	0
2.	East	102,0	*	0,8	*	0,32	*	39	or	23	=	973	or	574
3.	South	22,1	*	0,8	*	0,06	*	82	or	40	=	80	or	39
4.	West	103,7	*	0,8	*	0,21	*	41	or	26	=	687	or	440
5.	Horizontal	0,0	*	0,0	*	0,40	*	56	or	36	=	0	or	0

Solar heating power P_S

Total = P_L 1 1740 W or P_L 2 1053 W

Internal heating load P_I

Spec. Power W/m² 1,6 * A_{TFA} m² 719 = P_I 1 1151 W or P_I 2 1151 W

Heating power (gains) P_G

P_G 1 W | P_G 2 W

$P_T + P_I$ = 2891 or 2204

$P_L - P_G$ = 31558 or 26806

Heating load P_H = 31558 W

Area specific space heating load PH / A_{TFA} = 43,9 W/m²

Input Max. Supply Air Temperature 52 °C

Max. Supply Air Temperature $\vartheta_{Supply,Max}$ 52 °C — Supply Air Temperature Without Heating $\vartheta_{Supply,Min}$ °C 12,8 °C 13,7

For comparison: heating load transportable by the supply Air. $P_{Supply\ Air,Max}$ = 9768 W specific: 13,6 W/m²

Supply Air Heating Sufficient? (Yes/No) no

EnerPHit planning:

SUMMER VENTILATION

Building:	Primary School 8 "Sveti Sveti Kiril I Metodi" - S		Building type:	School	
Building volume:	1798	m³	Heat recovery η_{HRV}:	81%	
Max. indoor absolute humidity:	12	g/kg	Energy recovery η_{ER}:	0%	
Internal humidity sources:	2	g/(m²h)	Subsoil heat exchanger η^*_{SHX}:	0%	

Results passive cooling

Frequency of overheating:	7,8%	at the overheating limit ϑ_{max} = 24 °C	**Results active cooling** Useful Cooling Demand:	5,3	kWh/(m²a)
Frequency of exceeded humidity:	0,0%		Dehumidification demand:	0,2	kWh/(m²a)
max. humidity:	11,2	g/kg			

Summer background ventilation to ensure adequate air quality

Air exchange via ventilation system with supply	1,30	1/h	HRV/ERV in Summer (check only one field)	
			None	x
			automatic bypass, controlled by temperature difference	
			automatic bypass, controlled by enthalpy difference	
			always	
Air exchange via extract air system	1,30	1/h		
			Specific power consumption (for extract air system)	0,40 Wh/m³
Window ventilation air exchange	0,09	1/h		

Effective air exchange

	$n_{V,system}$ 1/h		η^*_{SHX}		η_{HR}		$n_{V,equi,fraction}$ 1/h
exterior $n_{V,e}$	1,300	*(1-	0%	)*(1-	0,81	) =	0,246
without HR	1,300	*(1-	0%	)		=	1,300
Ground nL,g	1,300	*	0%	*(1-	0,81	) =	0,000
without HR	1,300	*	0%			=	0,000

Ventilation conductance

	V_V m³		$n_{V,equi,fraction}$ 1/h		c_{Air} Wh/(m³K)			
exterior $H_{V,e}$	1798	*	0,246	*	0,33	=	146,1	W/K
without HR	1798	*	1,300	*	0,33	=	771,5	W/K
Ground $H_{V,g}$	1798	*	0,000	*	0,33	=	0,0	W/K
without HR	1798	*	0,000	*	0,33	=	0,0	W/K
Infiltration, window, extract air system	1798	*	1,658	*	0,33	=	983,8	W/K

Additional Summer Ventilation for Cooling

Additional ventilation regulation

Minimum Acceptable Indoor Temperatur: 22,0 °C

Type of additional ventilation

Window Night Ventilation, Manual	Night ventilation value	0,00 1/h		
	Corresponding air change rate	1,30 1/h		Controlled by (please cl
mechanical, automatically Controlled ventilation	during operation, in addition to base air change		Temperature difference	
	Specific power consumption	0,40 Wh/m³	Humidity difference	x

Secondary Calculation: hygienic air exchange through window ventilation

Estimation for window air exchange to ensure sufficient air quality

Description								
Open duration [h/d]	2	2						
Climate Boundary Conditions								
Temperature Diff Interior - Exterior	4	4						K
Wind Velocity	1	1						m/s
Window Group 1								
Quantity	10	10						
Clear Width	0,55	0,70						m
Clear Height	1,25	1,90						m
Tilting window (check if appropriate	x	x						
Opening Width (for tilting windows)	0,070	0,070						m
Window Group 2 (Cross Ventilation)								
Quantity	10	10						
Clear Width	0,60	0,75						m
Clear Height	1,35	1,35						m
Tilting window (check if appropriate	x	x						
Opening Width (for Tilting Window	0,070	0,070						m
Difference in Height to Window 1								m
							Total	
Result: air exchange	0,04	0,05	0,00	0,00	0,00	0,00	0,09	1/h

Secondary calculation: additional night ventilation for cooling

Air change value during additional window night ventilation

Description								
Reduction Factor	100%	100%						
Climate Boundary Conditions								
Temperature Diff Interior - Exterior	1	1	1	1	1	1		K
Wind Velocity	0	0	0	0	0	0		m/s
Window Group 1								
Quantity	10	10						
Clear Width	0,55	0,70						m
Clear Height	1,25	1,90						m
Tilting window (check if appropriate	x	x						
Opening Width (for Tilting Window	0,070	0,070						m
Window Group 2 (Cross Ventilation)								
Quantity	10	10						
Clear Width	0,60	0,75						m
Clear Height	1,35	1,35						m
Tilting window (check if appropriate	x	x						
Opening Width (for Tilting Window	0,070	0,070						m
Difference in Height to Window 1								m
							Total	
Result: night ventilation values	0,15	0,22	0,00	0,00	0,00	0,00	0,37	1/h

EnerPHit planning:

SUMMER: PASSIVE COOLING

Climate:	Велико Търнов	Building type:	School
Building:	Primary School 8 "Sveti Sveti Kiril I Metodi" - Section C	Treated Floor Area A_{TFA}:	719,4 m²
Overtemperature limit:	24 °C	Building volume:	1798 m³
Nominal humidity:	12 g/kg	Internal humidity sources:	2,0 g/(m²h)
Spec. Capacity:	204 Wh/(m²K)		

	Building assembly	Temperature Zone	Area m²		U-Value W/(m²K)		Red. Factor $f_{T,Summer}$		H_{Summer} Heat Conductance
1.	Exterior Wall - Ambient	A	518,5	*	0,141	*	1,00	=	72,9
2.	Exterior Wall - Ground	B	235,9	*	0,271	*	1,00	=	63,8
3.	Roof/Ceiling - Ambient	A	400,3	*	0,113	*	1,00	=	45,1
4.	Floor slab / basement ceili	B	400,3	*	0,302	*	1,00	=	120,8
5.	Floor over unheated basemer	B		*		*	1,00	=	
6.		A		*		*	1,00	=	
7.		X		*		*	0,75	=	
8.	Windows	A	227,8	*	2,749	*	1,00	=	626,4
9.	Exterior Door	A	2,5	*	2,250	*	1,00	=	5,7
10.	Exterior TB (length/m)	A	164,6	*	0,087	*	1,00	=	14,3
11.	Perimeter TB (length/m)	P	59,1	*	-0,028	*	1,00	=	-1,7
12.	Ground TB (length/m)	B		*		*	1,00	=	

Exterior Thermal Transmittance, $H_{T,e}$ 764,4 W/K

Ground Thermal Transmittance, $H_{T,g}$ 182,9 W/K

Summer Ventilation

from 'SummVent' worksheet

Ventilation unit conductance

Exterior $H_{V,e}$	146,1	W/K
without HR	771,5	W/K
Ground HV,g	0,0	W/K
without HR	0,0	W/K

Ventilation conductance, others

Exterior	983,8	W/K

Ventilation parameter

Temperature amplitude summer	11,2	K
Minimum Acceptable Indoor Temperature	22,0	°C
Heat capacity air	0,33	Wh/(m³K)
Supply air exchange	1,30	1/h
Ambient air exchange	1,66	1/h
Window night ventilation air exchange rate, manual @ 1K	0,00	1/h
Air change rate due to mechanical, automatically controlled ventilation	1,30	1/h
Specific power consumption for	0,40	Wh/m³
η_{HR}	81%	
η_{ERV}	0%	
η^*_{SHX}	0%	

Summer ventilation regulation

	HRV/ERV
None	x
Controlled by temperature	
Controlled by enthalpy	
always	
	Additional ventilation
Controlled by temperature	
Controlled by humidity	x

Solar Aperture

	Orientation of the area	Angle Factor Summer		Shading Factor Summer		Loss-Dirt		g-Value (perp. radiation)		Area m²		Portion of Glazing	=	**Aperture** m²
1.	North	0,9	*	1,00	*	0,95	*	0,00	*	0,0	*	0%	=	0,0
2.	East	0,9	*	0,55	*	0,95	*	0,77	*	102,0	*	51%	=	18,6
3.	South	0,9	*	0,28	*	0,95	*	0,77	*	22,1	*	53%	=	2,1
4.	West	0,9	*	0,28	*	0,95	*	0,77	*	103,7	*	51%	=	9,9
5.	Horizontal	0,9	*	1,00	*	0,95	*	0,00	*	0,0	*	0%	=	0,0
6	Sum opaque areas													2,5

Total 33,2 m²/m² 0,05

Internal Heat Gains Q_I

Specif. Power q_I W/m²		A_{TFA} m²	=	W	W/m²
5,4	*	719	=	3906	5,4

Frequency of Overheating $h_{\vartheta \geq \vartheta max}$ **7,8%** **At the overheating limit ϑ_{max} = 24 °C**

If the "frequency over 25°C" exceeds 10%, additional measures to protect against the heat during the summer are necessary.

Daily internal temperature stroke

Transmission kWh/d		Ventilation kWh/d		Solar load kWh/d		1/k		Spec. Capacity Wh/(m²K)		A_{TFA} m²			
(102,7	+	325,4	+	162,4	) *	1000	/ (	204	*	719	) =	**4,0**	K

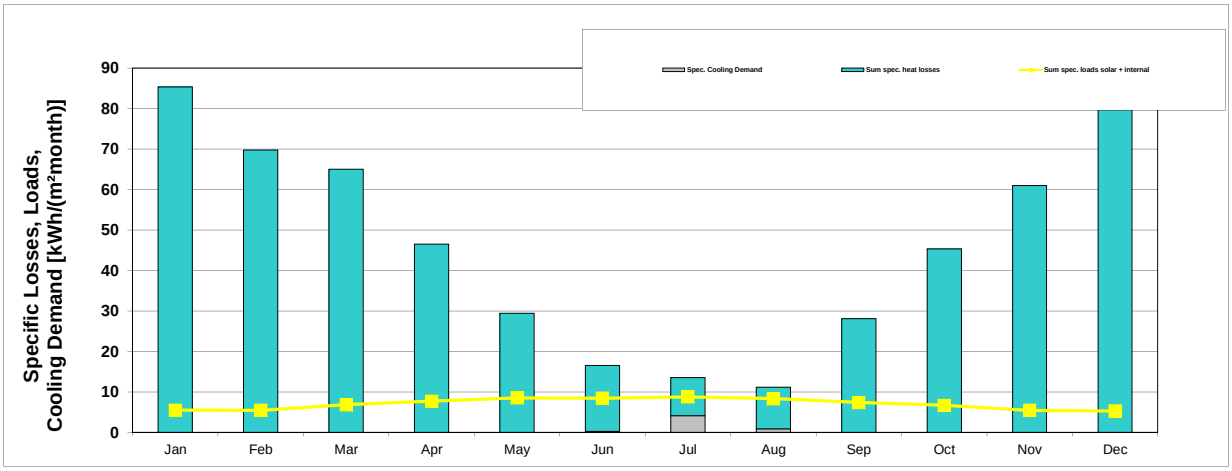
EnerPHit planning:

SPECIFIC USEFUL COOLING DEMAND

Climate: Велико Търнов
Building: Primary School 8 "Sveti Sveti Kiril I Metodi" - Section C

Interior Temperature: 24 °C
Building type: School
Treated Floor Area A_{TFA}: 719 m²

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Heating Degree Hours - Exterior	18,8	15,3	14,2	10,1	6,3	3,5	1,9	2,2	6,1	10,0	13,4	18,2	120	kKh
Heating Degree Hours - Ground	9,6	9,1	10,0	9,1	8,3	5,6	4,8	4,3	5,5	6,4	7,2	8,6	88	kKh
Losses - Exterior	47183	38393	35582	25187	15528	8496	4659	5223	15198	24879	33677	45674	299678	kWh
Losses - Ground	1769	1684	1849	1671	1532	1029	884	789	1022	1178	1329	1590	16324	kWh
Losses summer ventilation	12450	10126	9379	6631	4079	2221	1267	1354	3995	6555	8884	12053	78995	kWh
Sum spec. heat losses	85,4	69,8	65,1	46,6	29,4	16,3	9,5	10,2	28,1	45,3	61,0	82,5	549,1	kWh/m²
Solar load North	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh
Solar load East	521	651	1023	1489	1805	1861	1917	1656	1303	930	521	447	14123	kWh
Solar load South	131	146	183	193	185	174	187	200	206	196	140	122	2063	kWh
Solar load West	311	391	623	774	916	906	963	917	765	593	353	269	7780	kWh
Solar load Horiz.	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh
Solar load Opaque	92	124	196	271	330	340	356	317	247	177	103	81	2634	kWh
Internal Heat Gains	2906	2625	2906	2813	2906	2813	2906	2906	2813	2906	2813	2906	34219	kWh
Sum spec. loads solar + internal	5,5	5,5	6,9	7,7	8,5	8,5	8,8	8,3	7,4	6,7	5,5	5,3	84,5	kWh/m²
Utilisation Factor Losses	6%	8%	11%	17%	29%	50%	50%	72%	26%	15%	9%	6%	15%	
Useful Cooling Energy Demand	0	0	0	2	19	169	2956	673	11	1	0	0	3831	kWh
Spec. Cooling Demand	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,2**	**4,1**	**0,9**	**0,0**	**0,0**	**0,0**	**0,0**	**5,3**	kWh/m²
specif. dehumidification demand	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,2**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,2**	kWh/m²
Sensible Fraction	100%	100%	100%	100%	100%	100%	94%	100%	100%	100%	100%	100%	96%	



EnerPHit planning:

SPECIFIC USEFUL COOLING DEMAND

(This page displays the sums of the monthly method over the cooling period))

Climate: Велико Търнов
Building: primary School 8 "Sveti Sveti Kiril I Metodi" - Section C
Interior temperature summer: 24 °C
Nominal humidity: 12 g/kg
Spec. Capacity: 204 Wh/(m²K)

Building type: School
Treated Floor Area A_{TFA}: 719,4 m²
Building volume: 1798 m³
Internal humidity sources: 2,0 g/(m²h)

	Building assembly	Temperature Zone	Area m²		U-Value W/(m²K)		Mon. Red. Fac.		G_t kKh/a		kWh/a	per m² Treated Floor Area
1.	Exterior Wall - Ambient	A	518,5	*	0,141	*	1,00	*	54	=	3952	5,49
2.	Exterior Wall - Ground	B	235,9	*	0,271	*	1,00	*	54	=	3440	4,78
3.	Roof/Ceiling - Ambient	A	400,3	*	0,113	*	1,00	*	54	=	2448	3,40
4.	Floor slab / basement c	B	400,3	*	0,302	*	1,00	*	54	=	6512	9,05
5.	Floor over unheated bas	B		*		*	1,00	*		=		
6.		A		*		*	1,00	*		=		
7.		X		*		*	0,75	*		=		
8.	Windows	A	227,8	*	2,749	*	1,00	*	54	=	33966	47,21
9.	Exterior Door	A	2,5	*	2,250	*	1,00	*	54	=	309	0,43
10.	Exterior TB (length/m)	A	164,6	*	0,087	*	1,00	*	54	=	778	1,08
11.	Perimeter TB (length/m)	P	59,1	*	-0,028	*	1,00	*	54	=	-90	-0,12
12.	Ground TB (length/m)	B		*		*	1,00	*		=		0,00

Transmission losses Q_T (negative: heat loads) — Total: 51315 kWh/a; 71,3 kWh/(m²a)

Summer Ventilation from 'SummVent' worksheet

Ventilation unit conductance

Exterior $H_{V,e}$	146,1	W/K
without HR	771,5	W/K
Ground HV,g	0,0	W/K
without HR	0,0	W/K

Ventilation conductance, others

Exterior	983,8	W/K

Ventilation parameter

Temperature amplitude summer	11,2	K
Minimum Acceptable Indoor Temperature	22,0	°C
Heat capacity air	0,33	Wh/(m³K)
Supply air exchange	1,30	1/h
Ambient air exchange	1,66	1/h
Window night ventilation air exchange rate, manual @ 1K	0,00	1/h
Air change rate due to mechanical, automatically controlled v	1,30	1/h
Specific power consumption for	0,40	Wh/m³
η_{HR}	81%	
η_{ERV}	0%	
η^*_{SHX}	0%	

Summer ventilation regulation

	HRV/ERV
None	x
Controlled by temperature	
Controlled by enthalpy	
always	
	Additional ventilation
Controlled by temperature	
Controlled by humidity	x

Hygienic air change

	$n_{V,system}$ 1/h		η^*_{SHX}		η_{HR} (considers bypass)		$n_{V,Rest}$ 1/h		$n_{V,equi,fraction}$ 1/h	
Effective Air Change Rate Ambient $n_{V,e}$	1,300	*(1-	0%	)*(1-	0,00	)+	1,658	=	2,958	
Effective Air Change Rate Ground $n_{V,g}$	1,300	*	0%	*(1-	0,00	)		=	0,000	

	V_V m³		$n_{V,equi,fraction}$ 1/h		c_{Air} Wh/(m³K)		G_t kKh/a		kWh/a	kWh/(m²a)
Ventilation losses ambient Q_V	1798	*	2,958	*	0,33	*	53	=	93389	129,8
Ventilation losses ground $Q_{V,e}$	1798	*	0,000	*	0,33	*	0	=	0	0,0
Heat losses summer ventilation	1798	*	1,117	*	0,33	*	54	=	35481	49,3

Ventilation heat losses Q_V — Total: 128870 kWh/a; 179,1 kWh/(m²a)

Total heat losses Q_L

Q_T kWh/a		Q_V kWh/a	=	kWh/a	kWh/(m²a)
51315	+	128870	=	180185	250,5

	Orientation of the area	Reduction Factor		g-Value (perp. radiation)		Area m²		Global Radiation kWh/(m²a)	=	kWh/a
1.	North	0,40	*	0,00	*	0,0	*	318	=	0
2.	East	0,24	*	0,77	*	102,0	*	644	=	11983
3.	South	0,13	*	0,77	*	22,1	*	709	=	1524
4.	West	0,12	*	0,77	*	103,7	*	653	=	6456
5.	Horizontal	0,40	*	0,00	*	0,0	*	1113	=	0
6.	Sum opaque areas									2234

Available Solar Heat Gains Q_S — Total: 22197 kWh/a; 30,9 kWh/(m²a)

Internal Heat Gains Q_I

kh/d		Length Heat. Period d/a		Spec. Power q_I W/m²		A_{TFA} m²	=	kWh/a	kWh/(m²a)
0,024	*	245	*	5,4	*	719,4	=	22969	31,9

Sum heat loads Q_F — Q_S + Q_I = 45166 kWh/a; 62,8 kWh/(m²a)

Ratio of Losses to Free Heat Gains — Q_L / Q_F = 3,99

Utilisation Factor Heat Losses η_G = 23%

Useful heat losses $Q_{V,n}$ — η_G * Q_L = 41335 kWh/a; 57,5 kWh/(m²a)

Useful Cooling Demand Q_K — Q_F - $Q_{V,n}$ = 3831 kWh/a; **5** kWh/(m²a)

Limiting value 15 kWh/(m²a)

Requirement met? - (Yes/No)

EnerPHit planning:

COMPRESSOR COOLING UNITS

Climate:	Велико Търнов		Building type:	School	
Building:	Primary School 8 "Sveti Sveti Kiril I Metodi" - Section C		Heated Floor Area A_{TFA}:	719,4	m²
Interior temperature summer:	24,0	°C	Mechanical cooling:		
Nominal humidity:	12,0	g/kg	Air exchange via ventilation system with supply air:	1,3	
Internal humidity sources:	2,0	g/(m²h)			

Supply Air Cooling

Please select in the Verification sheet "Mechanical cooling".

check as appropriate

On/Off Mode (check as appropriate)		
max. cooling capacity (sensible + latent)	0,0	kW
Temperature reduction dry	0,0	K
Seasonal energy efficiency ratio	1,0	

Recirculation Cooling

check as appropriate

On/Off Mode (check as appropriate)		
max. cooling capacity (sensible + latent)	0,0	kW
Volume flow rate at nominal power	0,0	m³/h
Temperature reduction dry		K
Variable volume flow (check if appropriate)		
Seasonal energy efficiency ratio	1,0	

Additional Dehumidification

check as appropriate

Waste heat to room (please check if applicable)		
Seasonal energy efficiency ratio	1,0	

Panel Cooling

check as appropriate

Seasonal energy efficiency ratio	1,0	

	sensible kWh/(m²a)		latent kWh/(m²a)		COP		lectricity Demand (kWh/a) kWh/(m²a)	Sensible Fraction
Useful cooling total	5,3		0,2					96%
Cooling contribution by:								
Supply Air Cooling	(	+		) /	1,0	=		
Recirculation Cooling	(	+		) /	1,0	=		
Dehumidification				/		=		0%
Remaining for Panel Cooling				/	1,0	=		100%
Total	(0,0	+	0,0	) /		=	0,0	0%
Unsatisfied Demand	0,0		0,0					

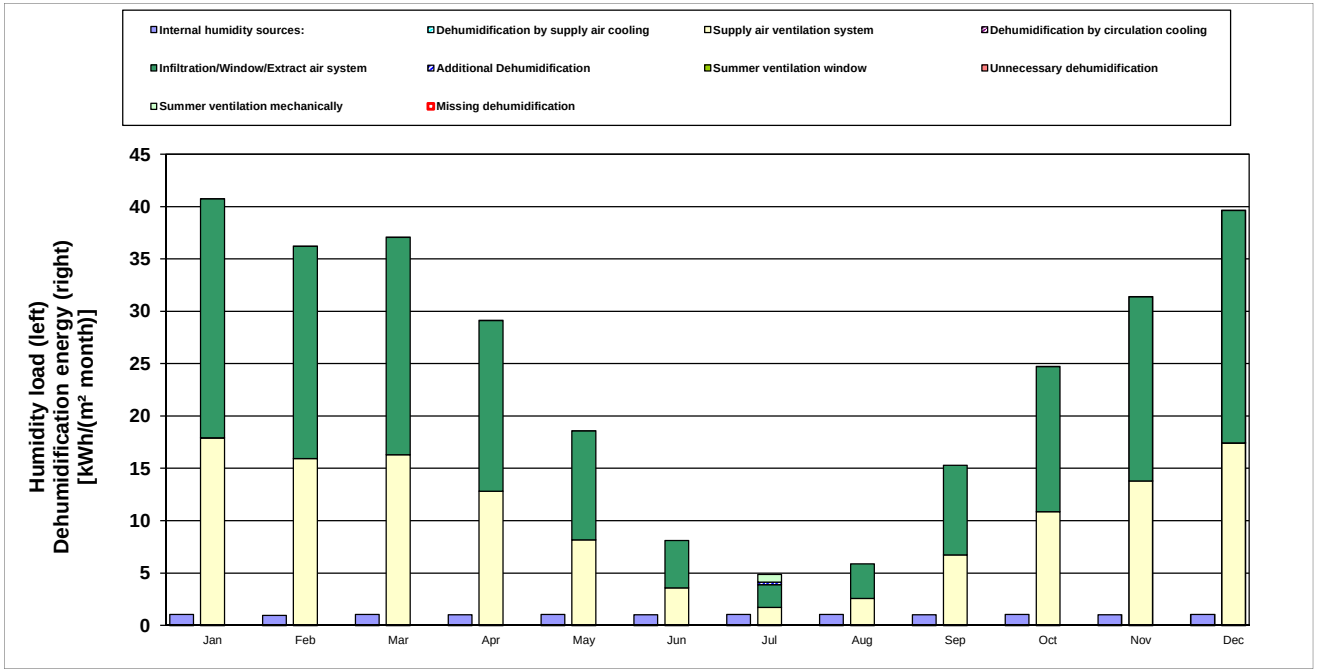
(Yes/No)

Cooling demand covered?

EnerPHit planning: **C O M P R E S S O R C O O L I N G U N I T S**

Humidity loads and humidity removal

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Internal humidity sources:	1,1	1,0	1,1	1,0	1,1	1,0	1,1	1,1	1,0	1,1	1,0	1,1	12	kWh/m²
Infiltration/Window/Extract air system	-22,9	-20,3	-20,8	-16,3	-10,4	-4,6	-2,2	-3,3	-8,6	-13,9	-17,6	-22,2	-163	kWh/m²
Supply air ventilation system	-17,9	-15,9	-16,3	-12,8	-8,2	-3,6	-1,7	-2,6	-6,7	-10,9	-13,8	-17,4	-128	kWh/m²
Summer ventilation window	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0	kWh/m²
Summer ventilation mechanically	0,0	0,0	0,0	0,0	0,0	0,0	-0,7	0,0	0,0	0,0	0,0	0,0	-1	kWh/m²
Total humidity load	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0	kWh/m²
Dehumidification by supply air cooling	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0	kWh
Dehumidification by circulation cooling	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0	kWh
Additional Dehumidification	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,0	0,0	0,0	0,0	0,0	0	kWh
Total dehumidification	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,0	0,0	0,0	0,0	0,0	0	
Unnecessary dehumidification	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0	kWh
Missing dehumidification	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0	kWh



EnerPHit planning: **COOLING LOAD**

Building: primary School 8 "Sveti Sveti Kiril I Metodi" - Section C

Building type: School

Climate (HL): Велико Търнов

Treated Floor Area A_{TFA}: 719,4 m²

Interior Temperature: 24 °C

Building volume: 1798 m³

Spec. Capacity: 204 Wh/(m²

Nominal humidity: 12,0 g/kg

Internal humidity sources: 2,0 g/kg

Temperature:	Ambient Air		Dew Point	Sky	
Weather 1:	27,9	°C	18,6	16,5	°C
Weather 2:	24,3	°C	18,6	18,6	°C
Ground Design Temp.	18,3	°C	SHX	11,4	°C

Radiation:	North	East	South	West	Horizontal	
	92	197	185	197	349	W/m²
	63	158	236	158	268	W/m²

	Building assembly	Temperature Zone	Area m²		U-Value W/(m²K)		Factor Always 1 (except "X")		TempDiff 1 K		TempDiff 2 K		P_T 1 W		P_T 2 W
1.	Exterior Wall - Ambient	A	518,5	*	0,141	*	1,00	*	3,9	or	0,3	=	282	or	19
2.	Exterior Wall - Ground	B	235,9	*	0,271	*	1,00	*	-5,7	or	-5,7	=	-366	or	-366
3.	Roof/Ceiling - Ambient	A	400,3	*	0,113	*	1,00	*	3,9	or	0,3	=	175	or	12
4.	Floor slab / basement ceiling	B	400,3	*	0,302	*	1,00	*	-5,7	or	-5,7	=	-694	or	-694
5.	Floor over unheated basement	B		*		*	1,00	*	-5,7	or	-5,7	=		or	
6.		A		*		*	1,00	*	3,9	or	0,3	=		or	
7.		X		*		*	0,75	*	3,9	or	0,3	=		or	
8.	Windows	A	227,8	*	2,749	*	1,00	*	3,9	or	0,3	=	2421	or	167
9.	Exterior Door	A	2,5	*	2,250	*	1,00	*	3,9	or	0,3	=	22	or	2
10.	Exterior TB (length/m)	A	164,6	*	0,087	*	1,00	*	3,9	or	0,3	=	55	or	4
11.	Perimeter TB (length/m)	P	59,1	*	-0,028	*	1,00	*	-5,7	or	-5,7	=	10	or	10
12.	Ground TB (length/m)	B		*		*	1,00	*	-5,7	or	-5,7	=		or	
13.	House/DU Partition Wall	I	28,6	*	0,782	*	1,00	*	4,0	or	4,0	=	89	or	89
14.	Radiation correction ambient air				$L_{ambient}$ W/K		-13,3	*	3,9	or	0,3	=	-52	or	-4
15.	Radiation correction sky				L_{Sky} W/K		13,2	*	-7,5	or	-5,4	=	-98	or	-71

Transmission heat load P_T Total = 1844 or -833

Ventilation load	V_V m³		$n_{V,equi,fraction}$ 1/h	or	$n_{V,equi,fraction}$ 1/h		c_{Air} Wh/(m³K)		TempDiff 1 K		TempDiff 2 K		P_V 1 W		P_V 2 W
Exterior $P_{V,e}$	1798	*	2,958	or	2,958	*	0,33	*	3,9	or	0,3	=	6786	or	467
Ground PL,e	1798	*	0,000	or	0,000	*	0,33	*	-12,6	or	-12,6	=	0	or	0
Summer ventilation $P_{L,S}$	1798	*	0,000	or	0,000	*	0,33	*	0,0	or	0,0	=	0	or	0

Ventilation heat load P_V Total = 6786 or 467

	Orientation of the area	Area m²		g-Value (perp. radiation)		Reduction Factor (see 'Windows' worksheet)		Radiation 1 W/m²		Radiation 2 W/m²		P_T 1 W		P_T 2 W
1.	North	0,0	*	0,0	*	0,40	*	92	or	63	=	0	or	0
2.	East	102,0	*	0,8	*	0,24	*	197	or	158	=	3666	or	2945
3.	South	22,1	*	0,8	*	0,13	*	185	or	236	=	398	or	508
4.	West	103,7	*	0,8	*	0,12	*	203	or	173	=	2012	or	1712
5.	Horizontal	0,0	*	0,0	*	0,40	*	349	or	268	=	0	or	0
6.	Sum opaque areas											693	or	549

Solar load P_S Total = 6768 or 5714

Internal heating load P_I Spec. Power 5,4 W/m² * A_{TFA} 719 m² = P_I 1: 3906 W or P_I 2: 3906 W

$P_T + P_V + P_S + P_I$ = 19304 or 9255

Cooling load P_C = 19304 W

Area specific cooling load P_C / A_{TFA} = 26,8 W/m²

Please enter the minimum supply air temperature. 3 °C

Supply air temperature without cooling $\vartheta_{Supply,Min}$ = °C 27,9 or °C 24,3

For comparison: cooling load, transportable through the supply air $P_{Supply;Max}$ = 19185 W or 16408 W

specific: 26,7 W/m² or 22,8 W/m²

Air conditioning over the supply air possible? (yes/no) no

Daily internal temperature stroke

(Transmission 1844,1 W + Ventilation 6786,3 W + Solar load 6767,6 W) * Time 24 h/d / (Spec. Capacity 204 Wh/(m²K) * A_{TFA} 719 m²) = 2,5 K

Dehumidification load from 'Cooling' worksheet

Absolute humidity exterior air	13,4	or	13,4	g/kg	Absolute humidity supply air	13,4	or	13,4	g/kg
Ambient air mass flow	3518	or	3518	kg/h	Supply air mass flow	2759	or	2759	kg/h
Summer ventilation air mass flow	0	or	0	kg/h	**Humidity load, supply air**	3982	or	3982	g/h
Humidity load, outside air	5078	or	5078	g/h	**Humidity load, internal**	1439	or	1439	g/h

Enthalpy of vaporisation 707,122 Wh/kg / 1000 g/kg * Humidity load 10499 g/h or 10499 g/h = P_D 1: 7424 W or P_D 2: 7424 W

Dehumidification load P_T = 7424 W

Area specific dehumidification load P_T / A_{TFA} = 10,3 W/m²

Monthly Average values

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Spec. Cooling Demand	0,0	0,0	0,0	0,0	0,0	0,2	4,1	0,9	0,0	0,0	0,0	0,0	kWh/m²
Specif. dehumidification demand	0,0	0,0	0,0	0,0	0,0	0,0	0,2	0,0	0,0	0,0	0,0	0,0	kWh/m²
Sensible Fraction	100%	100%	100%	100%	100%	100%	94%	100%	100%	100%	100%	100%	

Minimum of sensible cooling load fraction occurred 100%

HEAT DISTRIBUTION AND DHW SYSTEM

Building: Primary School 8 "Sveti Sveti Kiril I Metodi" - Section C

Interior Temperature:	18	°C
Building type:	School	
Treated Floor Area A_{TFA}:	719	m²
Occupancy:	60,0	Pers
Number of dwelling units:	1	
Annual heating demand qHeating	39328	kWh/a
Length of Heating Period:	194	d
Average heating load Pave:	8,4	kW
Marginal Utilisability of Additional Heat Gains:	96%	

Parts

			Warm region	Cold Region		Total		
Space Heat Distribution			1	2	3			
Length of Distribution Pipes	L_H *(Project)*		12,00				m	
Heat Loss Coefficient per m Pipe	Ψ *(Project)*		0,198				W/(mK)	
Temperature of the Room Through Which the Pipes	ϑ_X *Mechanical Room*		18				°C	
Design Flow Temperature	ϑ_{dist} *Flow, Design Value*		55,0				°C	
Design system heating load	$P_{heating}$ *(exist./calc.)*		14,0				kW	
Flow Temperature Control (check)			x					
Design Return Temperature	ϑ_R	=0.714*(J_{dist}-20)+20	45,0				°C	
Annual Heat Emission per m of Plumbing	q^*_{HL}	= Y (J_m–ϑ_X) $t_{Heating}$*0.024	21				kWh/(m·a)	
Possible Utilization Factor of Released Heat	η_G		96%				-	
Annual Losses	Q_{HL}	= L_H · q^*_{HL} · (1-η_G)	10	0	0	10	kWh/a	
Specif. losses	q_{HL}	= ΣQ_{HL} / A_{TFA}					kWh/(m²a)	0,0
'Performance ratio of heat distribution	$e_{a,HL}$	= (q_H + q_{HV}) / q_H				100%	-	
DHW: Standard Useful Heat								
DHW Consumption per Person and Day (60 °C)	V_{DHW} *(Project or Average Value 25 Litres/P/d)*					10,0	Litre/Person/d	
Average Cold Water Temperature of the Supply	ϑ_{DW} *Temperature of drinking water*					11,4	°C	
DHW Non-Electric Wash and Dish	*(Electricity worksheet)*					0	kWh/a	
Useful heat - DHW	Q_{DHW}					12342	kWh/a	
Specif. useful heat - DHW	q_{DHW}	= Q_{DHW} / A_{TFA}					kWh/(m²a)	17,2
DHW Distribution and Storage			Warm region	Cold Region		Total		
Length of Circulation Pipes (Flow + Return)	L_{HS} *(Project)*		8,0				m	
Heat Loss Coefficient per m Pipe	Ψ *(Project)*		0,198				W/m/K	
Temperature of the Room Through Which the Pipes	ϑ_X *Mechanical Room*		18				°C	
Design Flow Temperature	ϑ_{dist} *Flow, Design Value*		60,0				°C	
Daily circulation period of operation.	td_{Circ} *(Project)*		12,0				h/d	
Design Return Temperature	ϑ_R	=0.875*(ϑ_{dist}-20)+20	55				°C	
Circulation period of operation per year	t_{Circ}	= 365 td_{Circ}	4380				h/a	
Annual Heat Released per m of Pipe	q^*_z	= Y (J_m–ϑ_X) t_{Circ}	34				kWh/m/a	
Possible Utilization Factor of Released Heat	η_{GDHW}	=$t_{heating}$/365d * η_G	51%				-	
Annual Heat Loss from Circulation Lines	Q_Z	= L_{HS} · q^*_Z ·(1-η_{GDHW})	134			134	kWh/a	
Total length of individual pipes	L_U *(Project)*		9,00				m	
Exterior pipe diameter	d_{U_Pipe} *(Project)*		0,008				m	
Tap openings per person per day			3	3	3		-	
Utilisation days per year			250	250	250		d	
Heat loss per tap opening	$q_{Individual}$	=($c_{pH2O}V_{H2O}$+$c_{pMat}V_{Mat}$)(ϑ_{dist}-ϑ_X)	0,0127				kWh/tap opening	
Amount of tap openings per year	n_{Tap}	= n_{Pers} · n_{Tap} · d / n_{WE}	45000				Tap openings per year	
Annual Heat Loss	q_U	= n_{Tap} · $q_{Individual}$	574				kWh/a	
Possible Utilization Factor of Released Heat	η_{G_U}	=$t_{heating}$/8760*η_G	51%				-	
Annual Heat Loss of individual pipes	Q_U	= q_U ·(1-η_{G_U})	281			281	kWh/a	
Average Heat Released from storage	P_S		133				W	
Possible Utilization Factor of Released Heat	η_{G_S}	=$t_{heating}$/8760*η_G	51%					
Annual Heat Losses from storage	Q_S	= P_S·8.760 kh·(1-η_{G_S})	571			571	kWh/a	
Total heat losses of the DHW system	Q_{WL}	= Q_Z+Q_U+Q_S				986	kWh/a	
Specif. losses of the DHW system	q_{WL}	= Q_{WL} / A_{TFA}					kWh/(m²a)	1,4
Performance ratio DHW-distribution + storage	$e_{a,WL}$	= (q_{TDHW} + q_{WV}) / q_{TDHW}				108%	-	
Total heating demand of DHW system	Q_{gDHW}	= Q_{DHW}+Q_{WL}				13329	kWh/a	
Totalspec. heating demand of DHW system	q_{gDHW}	= Q_{gDHW} / A_{TFA}					kWh/(m²a)	18,5

Secondary calculation: Ψ-values of plumbing

Nominal width:	50	mm
Insulation Thickness:	60	mm
Mirrored?		Yes
	x	No
Thermal Conductivity	0,040	W/(mK)
$\Delta\vartheta$	30	K
Interior Pipe Diameter:	0,050	m
Exterior Pipe Diameter	0,052	m
Exterior Pipe Diameter	0,172	m
α–Surface	6,05	W/(m²K)
Ψ-Value	**0,198**	**W/(mK)**
Surface Temperature Difference	1,812	K

EnerPHit planning:

SOLAR THERMAL SYSTEM

Building: Primary School 8 "Sveti Sveti Kiril I Metodi" - Section C

Building type: School

Treated Floor Area A_{TFA}: 719,4 m²

Solar fraction

Heating Demand DHW	q_{gDHW}	13329	kWh/a	*(DHW+Distribution)*
Annual heating demand		39339	kWh/a	*(Worksheets Heating & DHW+Distribution)*
Heating support (please check, if applicable)				
DHW priority (check if appropriate)		x		
Latitude:		43,1	°	*(Worksheet Climate)*

Collector: Improved flat plate PK SL AL

Solar Collector Area		0,00	m²
Deviation from North		180	°
Angle of Inclination from the Horizontal		45	°
Height of the Collector Field		1,00	m
Height of Horizon	h_{Hori}		m
Horizontal Distance	a_{Hori}		m
Additional Reduction Factor Shading	r_{other}		

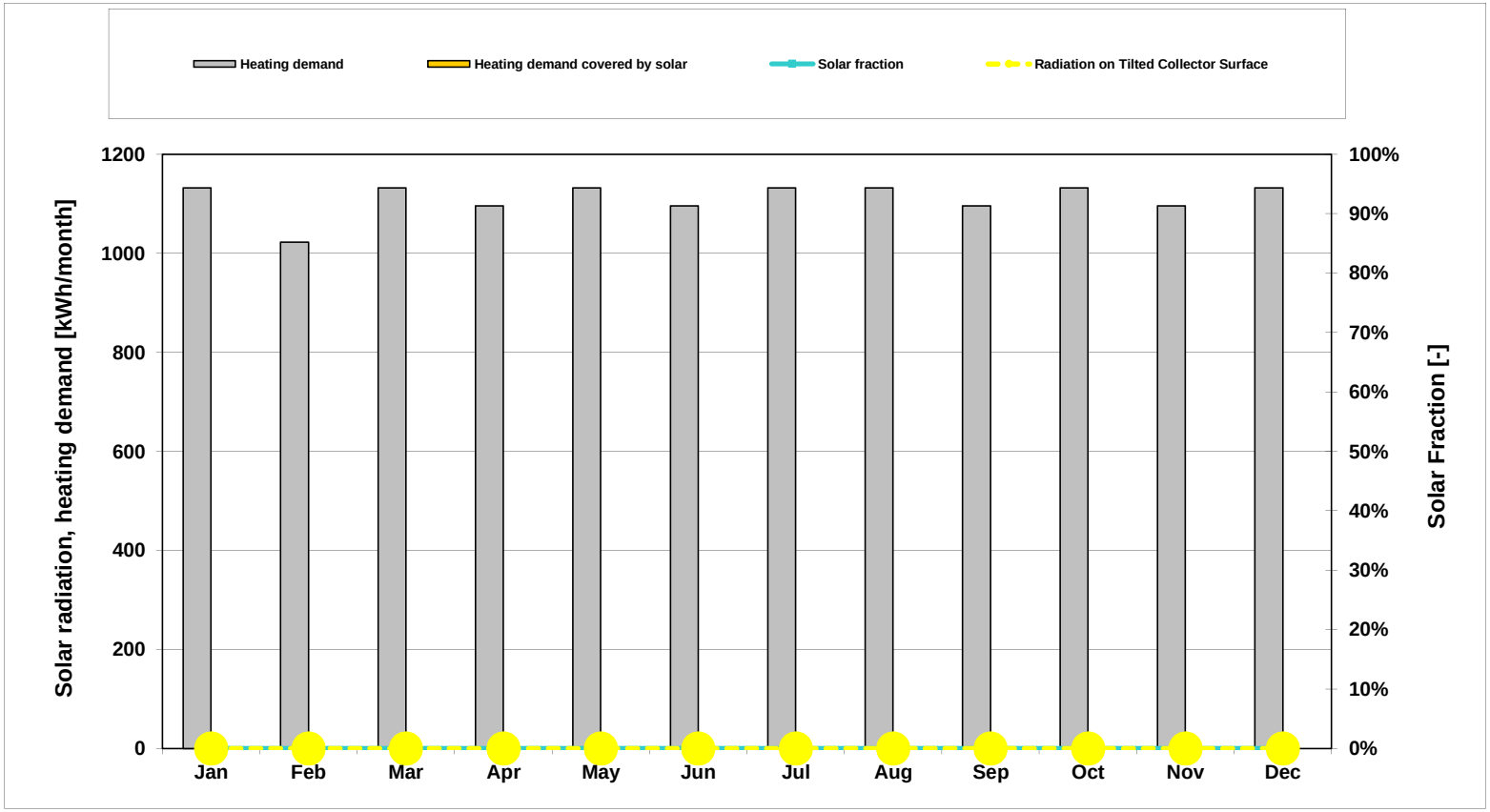
Occupancy	60,0	Persons
Specific Collector Area	0,0	m²/Pers

Estimated solar DHW fraction	**0%**	**0**	kWh/a	**0**	kWh/(m²a)
Estimated solar coverage for heating	**0%**	**0**	kWh/a	**0**	kWh/(m²a)
Solar heat contribution total	**0%**	**0**	kWh/a	**0**	kWh/(m²a)

Secondary Calculation of Storage Losses

Solar Storage: Simple storage 800 l

Total storage volume	800	litre	
Volume Standby Part (above)	240	litre	
Volume Solar Part (below)	560	litre	
Specific heat losses storage (total)	3,8	W/K	
Typical Temperature DHW	60	°C	
Room Temperature	20	°C	
Storage heat losses (standby part only)	**40**	W	
Total storage heat losses	**152**	W	



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Heating demand DHW-preparation	1132	1022	1132	1096	1132	1096	1132	1132	1096	1132	1096	1132	13329	kWh/month
Heating demand space heating	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh/month
Heating demand	1132	1022	1132	1096	1132	1096	1132	1132	1096	1132	1096	1132	13329	kWh/month
Radiation on Tilted Collector Surface	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh/month
Please enter: Solar production for DHW													0	kWh/month
Please enter: Solar production for heating													0	kWh/month
DHW heat demand covered by solar	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh/month
Heating demand covered by solar	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh/month
Heating demand covered by solar	0	0	0	0	0	0	0	0	0	0	0	0	0	kWh/month
Solar fraction	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-

Hit planning:

PHOTOVOLTAIC SYSTEM

Building: Primary School 8 "Sveti Sveti Kiril I Metodi" - Section C

Climate: Велико Търнов

Building type: School

Information from the module data sheet

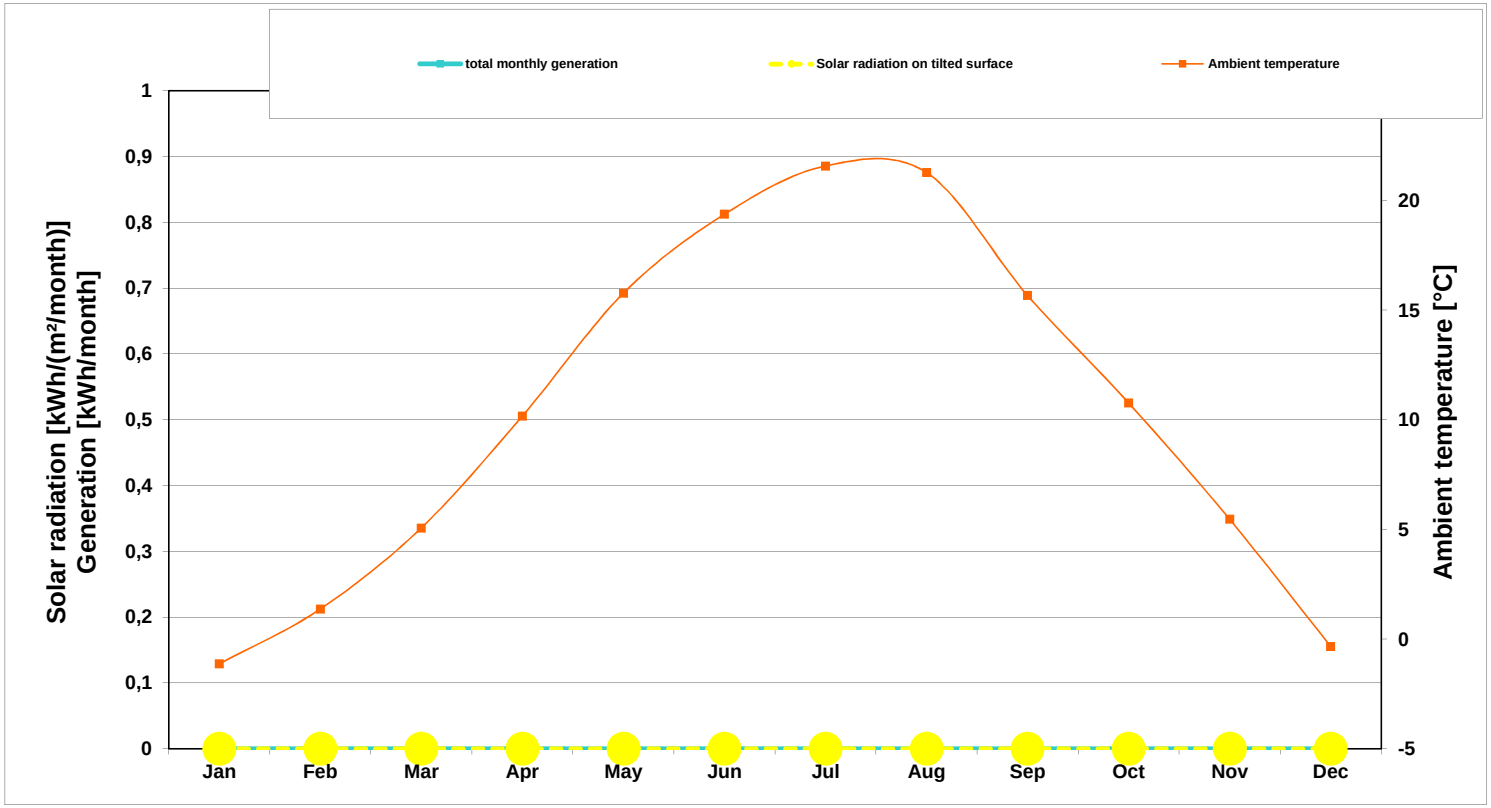
Technology: Amorph-Si

Nominal current	I_{MPP0}		A
Nominal voltage	U_{MPP0}		V
Nominal power	P_n	0	W_p
Temperature coefficient short-circuit current	α		%/K
Temperature coefficient open-circuit voltage	β		%/K

Further specifications

Latitude:		43,1	°	*(Worksheet Climate)*
Number of modules	n_M			
Deviation from North			°	
Angle of inclination from the horizontal			°	
Height of module array			m	
Height of horizon	h_{Hori}		m	
Horizontal distance	a_{Hori}		m	
Additional Reduction Factor Shading	r_{other}			
Efficiency of the inverter	η_{HRV}			

Annual yield of the inverter		kWh
Annual losses due to shading		kWh
PE value (non-renewable)		
CO_2-equivalent emission value		g/kWh



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		Year	
Solar radiation on tilted surface													kWh/m²/Month		kWh/m²/a
Ambient temperature	-1	1	5	10	16	19	22	21	16	11	5	0	°C	10,4	°C
total monthly generation													kWh/month		kWh/a
Losses due to shading situation													kWh/month		kWh/a

EnerPHit planning: **ELECTRICITY DEMAND**

Building: Primary School 8 "Sveti Sveti Kiril I Metodi" **Calculation in worksheet 'Electricity non-res'!**

Households	1	HH
Persons	60,0	P
Living Area	719	m²
Annual heating demand	55	kWh/(m²a)

Solar fraction of DHW Laundry&Dish	
Marginal Performance Ratio DHW	110%
Marginal Performance Ratio Heating	110%

Prim. Energy Factors:	Electricity	2,6	kWh/kWh
	Natural Gas	1,1	kWh/kWh
Energy Carrier for Space Heating/DHW:		1,1	1,1

Column Nr.	1	2	3				4		5			6			7		8	8a		9		10		11		12		13		14
Application	Used ? (1/0)	Within the Thermal Envelope? (1/0)	Norm Demand				Utilization Factor		Frequency			Reference Quantity			Useful Energy (kWh/a)		Electric Fraction	Non-Electric Fraction		**Electricity Demand (kWh/a)**		Additional demand		Marginal Performance Ratio		Solar Fraction		Non-Electric Demand (kWh/a)		**Primary Energy-Demand (kWh/a)**
Dishwashing	1	1	1,10	kWh/Use		*	1,00	*	65	/(P*a)	*	60,0	P	=	4290	*	100%		=	**4290**									**11154**
Cold water connection																*		0%			* (1+	0,30	) *	1,10	*(1-		) =		
Clothes washing	1	1	1,10	kWh/Use		*	1,00	*	57	/(P*a)	*	60,0	P	=	3762	*	100%		=	**3762**									**9781**
Cold water connection																*		0%			* (1+	0,05	) *	1,10	*(1-		) =		
Clothes drying with:	1	1	3,50	kWh/Use	Residual dampness		0,88	*	57	/(P*a)	*	60,0	P	=	10474		100%		=	**10474**									**27232**
Condensation Dryer					0,60									=	0			0%					1,00	*			**0**		**0**
Energy consumed by evaporation	0	1	3,13	kWh/Use		*	0,60	*	57	/(P*a)	*	60,0	P	=	0	*	100%				* (1+	0,00	) *	1,10	*(1-	0,69	) =	**0**		**0**
Refrigerating	1	1	0,78	kWh/d		*	1,00	*	365	d/a	*	1	HH	=	285	*	100%		=	**285**									**740**
Freezing	1	0	0,88	kWh/d		*	0,90	*	365	d/a	*	1	HH	=	289	*	100%		=	**289**									**752**
or combination	0	1	1,00	kWh/d		*	1,00	*	365	d/a	*	1	HH	=	0	*	100%		=	**0**									**0**
Cooking with:	1	1	0,25	kWh/Use		*	1,00	*	500	/(P*a)	*	60,0	P	=	7500	*	100%		=	**7500**									**19500**
Electricity					Percentage CFLs											*		0%										**0**	**0**
Lighting	1	1	60	W	0%	*	1,00	*	2,90	kh/(P*a)	*	60,0	P	=	10440	*	100%		=	**10440**									**27144**
Consumer electronics	1	1	80	W		*	1,00	*	0,55	kh/(P*a)	*	60,0	P	=	2640	*	100%		=	**2640**									**6864**
Small appliances, etc.	1	1	50	kWh		*	1,00	*	1,00	/(P*a)	*	60,0	P	=	3000	*	100%		=	**3000**									**7800**
Total aux. electricity															14965					**14965**									**38909**
Other:																													
				kWh/a											0					**0**									**0**
				kWh/a											0					**0**									**0**
				kWh/a											0					**0**									**0**
Total															**57644**	**kWh**				**57644**	kWh		DHW Non-Electric - Wash&Dish **0**		kWh		**0**		**149876**
																							Non-Renewable Non-Electric DHW Wash&Dish						
Specific Demand																				**80,1**	kWh/(m²a)		**0,0**		kWh/(m²a)		**0,0**		**208,3**
Recommended maximum value																				**18**									**50**

EnerPHit planning:

U T I L I S A T I O N non-residential Use

Building: **Primary School 8 "Sveti Sveti Kiril I Metodi" - Section C**

Latitude [°]: **43**

	Utilisation Pattern	Periods of utilisation and operation	Begin Utilisation [h]	End Utilisation [h]	Daily Utilisation Hours [h/d]	Annual Utilisation Days [d/a]	Annual Utilisation Hours [h/a]	Annual Utilisation Hours During Daytime [h/a]	Annual Utilisation Hours During Nighttime [h/a]	Daily operating hours of heating	Daily operating hours of ventilation	Lighting	Illumination Level [lux]	Height of utilisation level (0.8 or 0.0 m)	Height of utilisation level (0.8 or 0.0 m)	Relative Absenteeism	Part Use Factor of Building Operating Period for Lighting	Average Occupancy [m²/Pers.]
1	**Lobbies**		**7,5**	**20**	12	**250**	3000	2627	373	14	14		**200**	**0,0**	0,0	**0,80**	**1,00**	
2	**Corridors**		**7,5**	**20**	12	**180**	2160	1891	269	14	14		**100**	**0,0**	0,0	**0,80**	**1,00**	
3	**WC, Sanitary**		**7,5**	**22**	15	**250**	3625	2630	995	17	17		**200**	**0,8**	0,8	**0,90**	**1,00**	
4					0		0	0	0	2	2				0,8			
5	**Teacher offices**		**7,5**	**18**	11	**180**	1890	1803	87	13	13		**300**	**0,8**	0,8	**0,30**	**0,70**	**10,0**
6	**Classroom**		**7,5**	**18**	11	**180**	1890	1803	87	13	13		**300**	**0,8**	0,8	**0,25**	**0,90**	**3,0**
7	**Stairs**		**7,5**	**22**	15	**250**	3625	2630	995	17	17		**100**	**0,0**	0,0	**0,80**	**1,0**	
8					0		0	0	0	2	2				0,8			
9					0		0	0	0	2	2				0,8			
10	**Gymnasium**		**7,5**	**22**	15	**250**	3625	2630	995	17	17		**300**	**0,8**	0,8	**0,30**	**1,0**	
11	**Changing-room**		**7,5**	**22**	15	**250**	3625	2630	995	17	17		**300**	**0,8**	0,8	**0,80**	**0,4**	
12	**Gymnasium saloon**		**7,5**	**22**	15	**250**	3625	2630	995	17	17		**300**	**0,8**	0,8	**0,30**	**1,0**	
13	**Gymnasium underground**		**7,5**	**14**	7	**180**	1170	1169	1	9	9		**300**	**0,8**	0,8	**0,30**	**1,0**	
14					0		0	0	0	2	2				0,8			
15					0		0	0	0	2	2				0,8			
16					0		0	0	0	2	2				0,8			
17					0		0	0	0	2	2				0,8			
18					0		0	0	0	2	2				0,8			
19					0		0	0	0	2	2				0,8			
20					0		0	0	0	2	2				0,8			
21	Single Office		7	18	11	250	2750	2543	207	13			500	0,8	0,8	0,30	0,70	10,00
22	Group Office		7	18	11	250	2750	2543	207	13			500	0,8	0,8	0,30	0,70	
23	Open-Plan Office		7	18	11	250	2750	2543	207	13			500	0,8	0,8	0,00	1,00	15,00
24	Meeting		7	18	11	250	2750	2543	207	13			500	0,8	0,8	0,50	1,00	2,00
25	Counter Area		7	18	11	250	2750	2543	207	13			200	0,8	0,8	0,00	1,00	
26	Retail		8	20	12	300	3600	2999	601	14			300	0,8	0,8	0,00	1,00	7,00
27	Classroom		8	15	7	200	1400	1398	2	9			300	0,8	0,8	0,25	0,90	2,00
28	University Auditorium		8	18	10	150	1500	1409	91	12			500	0,8	0,8	0,25	0,70	0,75
29	Bedroom		0	24	24	365	8760	4407	4353	24			300	0,8	0,8	0,00	0,50	
30	Hotel Room		21	8	11	365	4015	755	3260	24			200	0,8	0,8	0,25	0,30	
31	Canteen		8	15	7	250	1750	1748	2	9			200	0,8	0,8	0,00	1,00	
32	Restaurant		10	0	14	300	4200	2404	1796	16			200	0,8	0,8	0,00	1,00	1,50
33	Kitchen Non-Residential		10	23	13	300	3900	2404	1496	15			500	0,8	0,8	0,00	1,00	
34	Kitchen, Storage, Preparation		7	23	16	300	3900	2404	1496	15			300	0,8	0,8	0,50	1,00	
35	WC, Sanitary		7	18	11	250	2750	2543	207	13			200	0,8	0,8	0,90	1,00	
36	Other Habitable Rooms		7	18	11	250	2750	2543	207	13			300	0,8	0,8	0,50	1,00	
37	Secondary Areas		7	18	11	250	2750	2543	207	13			100	0,8	0,8	0,90	1,00	
38	Circulation Area		7	18	11	250	2750	2543	207	13			100	0,0	0,0	0,80	1,00	
39	Storage, Services		7	18	11	250	2750	2543	207	13			100	0,8	0,8	0,98	1,00	
40	Server Room		0	24	24	365	8760	4407	4353	24			500	0,8	0,8	0,50	0,50	
41	Workshop		7	16	9	250	2250	2192	58	11			500	0,8	0,8	0,00	1,00	
42	Theatre Auditorium		19	23	4	250	1001	55	946	6			200	0,8	0,8	0,00	1,00	
43	Theatre Foyer		19	23	4	250	1001	55	946	6			300	0,8	0,8	0,50	1,00	
44	Theatre Stage		13	23	10	250	2500	1253	1247	12			1000	0,8	0,8	0,00	0,60	
45	Fair, Congress		13	18	5	150	1350	1260	90	11			300	0,8	0,8	0,50	1,00	
46	Exhibition		10	18	8	250	2001	1850	151	24			200	0,8	0,8	0,00	1,00	
47	Library Reading Room		8	20	12	300	3600	2999	601	14			500	0,8	0,8	0,00	1,00	
48	Open Access Library		8	20	12	300	3600	2999	601	14			200	0,8	0,8	0,00	1,00	
49	Library Repository		8	20	12	300	3600	2999	601	14			100	0,8	0,8	0,90	1,00	
50	Gymnasium		8	23	15	300	4500	3002	1498	17			300	0,8	0,8	0,30	1,00	
51	Parking Garage		7	18	11	250	2750	2543	207	0			75	0,0	0,0	0,95	1,00	
52	Public Parking Garage		9	0	15	365	5475	3290	2185	0			75	0,0	0,0	0,80	1,00	

EnerPHit planning: **E L E C T R I C I T Y D E M A N D Non-Residential Use**

Building: Primary School 8 "Sveti Sveti Kiril I Metodi" - Section C

Treated Floor Area A_{TFA}: 719,4 m²

Auxiliary Electricity Demand: 14965,0 kWh/a

Primary Energy factors:

Electricity:	2,6	kWh/kWh
Natural gas:	1,1	kWh/kWh
Energy Carrier for DHW:		kWh/kWh
Solar fraction of DHW	0%	
Marginal Performance Ratio DHW:		

Window Properties (from Windows worksheet):

	Shading	Dirt Factor	Non-Perpendicular Radiation	Glazing Fraction
North	1,00	0,95	0,85	0,00
East	0,78			0,51
South	0,13			0,53
West	0,51			0,51

Lighting / non-residential	Percentage of treated floor area	Room Category	Room Category	Nominal Illuminance Level	Facade with Windows: Deviation from North	Facade with Windows: Orientation	Facade with Windows: Light Transmission Glazing	Facade with Windows: Existing window	Room Geometry: Input of a Typical Room or Room by Room: Room Depth	Room Width	Room Height	Lintel Height	Window Width	Input Warning	Daylight Utilisation	User Data: Installed Lighting Power	Installed Lighting Power (Standard)	Lighting Control	With motion?	Lighting Control	Utilisation Hours per Year [h/a]	User Determined: Lighting Full Load Hours	Full Load Hours of Lighting	Electricity Demand (kWh/a)	Spec. Electricity Demand (kWh/(m²a))	Primary Energy Demand (kWh/a)
Room / Zone				Lux	Degrees		-	[x]	m	m	m	m	m			W/m²	W/m²		[x]		h/a	h/a	h/a	kWh/a	kWh/(m²a)	kWh/a
		2		15																			9				
Walkway - level -1	1%	2	Corridors	100	90	East	78%	x	1,7	6,0	3,0	2,7	3,6		good		4,6	1		Manual	Without motion	2160		1120,0	46,3	5,2	120,5
Walkway - level -1	1%	2	Corridors	100	260	West	78%	x	1,7	6,0	3,0	2,7	3,6		medium		4,6	1		Manual	Without motion	2160		1150,0	47,6	5,3	123,7
Entrance	4%	1	Lobbies	200	260	West	78%	x	1,8	5,8	3,0	2,7	1,2		low		7,2	1		Manual	Without motion	3000		1910,0	395,7	13,8	1028,9
Antechamber	4%	1	Lobbies	200	180	South	78%	x	5,6	2,9	3,0	2,7	1,2		none		7,2	1		Manual	Without motion	3000		2050,0	446,0	14,8	1159,5
Changing-room	1%	11	Changing-room	300	90	East	78%	x	3,8	2,7	3,0	2,7	1,2		low		9,8	1		Manual	Without motion	3625		944,0	93,2	9,3	242,3
WC	1%	35	WC, Sanitary	200	180	South	78%	x	1,3	3,8	3,0	2,7	1,8		none		7,2	1		Manual	Without motion	2750		1670,0	112,4	12,0	292,4
Gymnasium - level -1	18%	13	Gymnasium underground	300	90	East	78%	x	5,8	23,6	4,9	4,4	12,0		medium		9,8	1		Manual	Without motion	1170		700,0	895,7	6,9	2328,8
Gymnasium - level -1	18%	13	Gymnasium underground	300	260	West	78%	x	5,8	23,6	4,9	4,4	12,0		low		9,8	1		Manual	Without motion	1170		750,0	959,7	7,4	2495,2
Walkway - level 0	2%	2	Corridors	100	90	East	78%	x	1,7	6,0	3,3	3,0	4,8		good		4,6	1		Manual	Without motion	2160		1110,0	55,1	5,1	143,3
Walkway - level 0	2%	2	Corridors	100	260	West	78%	x	1,7	6,0	3,3	3,0	4,8		good		4,6	1		Manual	Without motion	2160		1120,0	55,6	5,2	144,5
Changing-room	2%	11	Changing-room	300	180	South	78%	x	5,6	2,9	3,3	2,7	1,8		none		9,8	1		Manual	Without motion	3625		1056,0	163,8	10,3	425,8
WC	3%	35	WC, Sanitary	200	180	South	78%	x	1,3	3,8	3,3	2,7	2,7		low		7,2	1		Manual	Without motion	2750		1610,0	216,8	11,6	563,7
Teachers office	1%	5	Teacher offices	300	260	West	78%	x	3,8	2,7	3,3	2,7	1,2		none		9,8	1		Manual	Without motion	1890		994,0	91,1	9,7	236,9
Entrance	1%	1	Lobbies	200	0	North	78%		1,2	7,7	3,3	2,7			none		7,2	1		Manual	Without motion	3000		2310,0	143,6	16,6	373,3
Changing-room 2	2%	11	Changing-room	300	180	South	78%	x	4,4	2,9	3,3	2,7	1,8		none		9,8	1		Manual	Without motion	3625		1052,0	118,7	10,3	308,5
Other 1	1%	5	Teacher offices	300	260	West	78%	x	2,1	3,0	3,3	2,7	0,9		low		9,8	1		Manual	Without motion	1890		875,0	49,4	8,6	128,3
Other 2	0%	5	Teacher offices	300	180	South	78%	x	1,3	2,1	3,3	2,7	0,9		none		9,8	1		Manual	Without motion	1890		994,0	21,0	9,7	54,7
Gymnasium - level 0	19%	12	Gymnasium saloon	300	90	East	78%	x	5,9	23,8	5,4	5,0	16,0		medium	6	5,7	1		Manual	Without motion	3625		2490,0	1904,2	14,2	4951,0
Gymnasium - level 0	19%	12	Gymnasium saloon	300	260	West	78%	x	5,9	23,8	5,4	5,0	16,0		low	6	5,7	1		Manual	Without motion	3625		2580,0	1973,0	14,7	5129,9
							78%								none		0,0			Manual	Without motion					0,0	
							78%								none		0,0			Manual	Without motion					0,0	
							78%								none		0,0			Manual	Without motion					0,0	

Office Equipment	Room Category	Room Category	In the thermal envelope? (1/0)	Existing/Planned? (1/0)		Quantity		Power Rating (W)		Utilisation Hours per Year (h/a)		relative absenteeism		Duration of Utilisation in Energy Saving Mode (h/a)		Useful Energy (kWh/a)		Electricity Demand (kWh/a)	Primary Energy Demand (kWh/a)
		2								9	20	18							
PC 1			0	0	*	0	*	55	* (	0	* (1-	0	)		=	0	=	0,0	0
PC in Energy Saving Mode			0			0	*	2,0	*	0	*	0			=	0	=	0,0	0
Monitor 1			0	0	*	0	*	20	* (	0	* (1-	0	)		=	0	=	0,0	0
Monitor in Energy Saving Mode			0			0	*	2,0	*	0	*	0			=	0	=	0,0	0
PC 2			0	0	*	0	*	55	* (	0	* (1-	0	)		=	0	=	0,0	0
PC in Energy Saving Mode			0			0	*	2,0	*	0	*	0			=	0	=	0,0	0
Monitor 2			0	0	*	0	*	20	* (	0	* (1-	0	)		=	0	=	0,0	0
Monitor in Energy Saving Mode			0			0	*	2,0	*	0	*	0			=	0	=	0,0	0
Copier			0	0	*	0	*	400	* (	0			-	0	) =	0	=	0,0	0
Copier in Energy Saving Mode			0			0	*	30	*	0					=	0	=	0,0	0
Printer			0	0	*	0	*	300	* (	0			-	0	) =	0	=	0,0	0
Printer in Energy Saving Mode			0			0	*	2	*	0					=	0	=	0,0	0
Server	5	Teacher offices	1	0	*	0	*	100	* (	1890					=	0	=	0,0	0
Server in Energy Saving Mode			1			0	*	2,0	* (	8760			-	1890	) =	0	=	0,0	0
Telephone System			1	0	*	1	*	94	*	8760					=	0	=	0,0	0
					*		*		*						=	0	=	0,0	0
					*		*		*						=	0	=	0,0	0
					*		*		*						=	0	=	0,0	0
					*		*		*						=	0	=	0,0	0
					*		*		*						=	0	=	0,0	0

Kitchen / Aux. Electricity	Room Category	Predominant Utilisation Pattern of Building	In the thermal envelope? (1/0)	Existing/Planned? (1/0)		Utilisation Days per Year (d/a)		Number of Meals per Utilisation Day		Norm Consumption		Useful Energy (kWh/a)		Non-Electric Fraction	Electric Fraction		Additional demand		Marginal Performance Ratio		Solar Fraction		Other Primary Energy Demand (kWh/a)	Electricity Demand (kWh/a)	Primary Energy Demand (kWh/a)
						8				kWh / Meal															
Cooking	31	Canteen			*	250	*	0	*	0,25	=	0	{ *		100%							=		0,0	0
Electricity										kWh / Cover			*	0%								=	0		0
Dishwashing					*	250	*	0	*	0,10	=	0	{ *		55%							=		0,0	0
DHW connection										kWh/d			*	45%		* (1+	0,30	) *	1,20	*(1-	0,00	) =	0		0
Refrigerating						365				0,38	=	0	*		100%							=		0,0	0
										0,25		0	*		100%							=		0,0	0
												0	*		100%							=		0,0	0
												0	*		100%							=		0,0	0
												0	*		100%							=		0,0	0
												0	*		100%							=		0,0	0
												0	*		100%					Hot Water Non-Electric Dishwashing		=		0,0	0
												0	*		100%							=		0,0	0
												0	*		100%							=		0,0	0
Total Auxiliary Electricity												14965												14965,0	38909
Total												22754	kWh							0			0	22754 kWh/a	59160 kWh/a
Specific Demand																				0,0			0,0	32 kWh/(m²a)	82 kWh/(m²a)

EnerPHit planning: # AUXILIARY ELECTRICITY

Building: Primary School 8 "Sveti Sveti Kiril I Metodi" - Section C

Treated Floor Area	719	m²
Heating period	194	d
Air Volume	1798	m³
Dwelling Units	1	HH
Enclosed Volume	4180	m³

Operation Vent. System Winter	4,66	kh/a
Operation Vent. System Summer	4,10	kh/a
Air Change Rate	0,42	h^{-1}
Defrosting HX from	4,0	°C

Primary Energy factor - Electricity	2,60	kWh/kWh
Annual Space Heating Demand	55	kWh/(m²a)
Boiler Rated Power	32	kW
DHW System Heating Demand	13329	kWh/a
Design Flow Temperature	55	°C

Column Nr.	1	2	3		4		5		6		7		8		9		10		11	12
Application	Used ? (1/0)	Within the Thermal Envelope? (1/0)	Norm Demand		Utilization Factor		Period of Operation		Reference Size		Electricity Demand (kWh/a)		Available as Interior Heat		Used During Time Period (kh/a)		Internal heat source Winter (W)		Internal heat source Summer (W)	Primary Energy Demand (kWh/a)
Ventilation System																				
Winter Ventilation	1		0,40	Wh/m³	* 0,42	h^{-1}	* 4,7	kh/a	* 1798	m³	= **1407**		considered in heat recovery efficiency							**3658**
Defroster HX	1	1	4110	W	* 1,00		* 0,8	kh/a	* 1		= **3139**	*	1,0	/	4,66	=	**674**			**8163**
Summer Ventilation	1	1,00	0,40	Wh/m³	* 2,60	h^{-1}	* 4,1	kh/a	* 1798	m³	= **7678**	*	1,0	/	4,10	=			**1870**	**19962**
																			Internal heat sources ' Additional summer ventilation' 0	
Additional ventilation summer	1		0,40	Wh/m³	* 0,44	h^{-1}	* 4,1	kh/a	* 1798	m³	= **1313**	*	1,0	/	4,10	=				**3414**
Heating System					Controlled/UnControlled (1/0)															
Enter the Rated Power of the pump				W																
Circulation Pump	1	1	159	W	* 1,0		* 4,7	kh/a	* 1		= **739**	*	1,0	/	4,66	=	**159**			**1921**
Boiler Electricity Consumption at 30% Load				W																
Aux. Energy - Heat. Boiler	1	0	79	W	* 1,00		* 4,10	kh/a	* 1		= **324**	*	1,0	/	4,66	=	**0**			**843**
Aux. Energy - Wood fired/pellet boiler	0	0	Data entries in Boiler worksheet. Auxiliary energy demand including possible drinking water prod.								**0**	*	1,0	/	4,66	=	**0**			**0**
DHW system																				
Enter average power consumption of pump				W																
Circulation Pump	1	1	38	W	* 1,00		* 7,0	kh/a	* 1		= **266**	*	0,5	/	8,76	=	**16**		**16**	**691**
Enter the Rated Power of the pump				W																
Storage Load Pump DHW			123	W	* 1,00		* 0,4	kh/a	* 1		= **0**	*	1,0	/	4,66	=	**0**		**0**	**0**
Boiler Electricity Consumption at 100% Load				W																
DHW Boiler Aux. Energy	1	0	238	W	* 1,00		* 0,4	kh/a	* 1		= **99**	*	1,0	/	4,66	=	**0**		**0**	**257**
Enter the Rated Power of the Solar DHW pump				W																
Solar Aux Electricity	0		97	W	* 1,00		* 1,8	kh/a	* 1		= **0**	*	0,5	/	8,76	=	**0**		**0**	**0**
Misc. Aux. Electricity																				
Misc. Aux. Electricity				kWh/a	* 1,00		* 1,0		* 1	HH	= **0**	*	1,0	/	8,76	=	**0**		**0**	**0**
Total											**14965**						**849**		**1887**	**38909**
Specific Demand	kWh/(m²a)		divided by treated floor area:								**20,8**									**54,1**

EnerPHit planning:

INTERNAL HEAT GAINS

Building: Primary School 8 "Sveti Sveti Kiril I Metodi" **Calculation in worksheet 'IHG non-res'!**

Utilisation Pattern: School — 1,34 W/m²

Type of Values Used: PHPP calculation ('IHG non-res' worksheet) — 9,00 W/m² in summer

1,34 W/m²

Go to utilisation pattern selection

Calculation Internal Heat Household

Persons 60,0 P

Living Area 719 m²

Heating Demand 55 kWh/(m²a)

Heating period 194 d/a

Column Nr.		1	2	3		4	5		6		7		8		9		10
Application		Existing (1/0), or number of people	In the Thermal Envelope (1/0)	Norm Consumption		Utilization Factor	Frequency		Useful Energy (kWh/a)		Included in Electricity Balance?		Availability		Used During Time Period (kh/a)		**Internal heat source Winter (W)**
Dishwashing		1	1	1,1	kWh/Use	1,00	65	/(P*a)	4290	*			0,30	/	8,76	=	**147**
Clothes Washing		1	1	1,1	kWh/Use	1,00	57	/(P*a)	3762	*			0,30	/	8,76	=	**129**
Clothes drying with:		1	1	3,5	kWh/Use	0,88	57	/(P*a)	10474	*			0,70	/	8,76	=	**837**
Condensation Dryer			1	0,0					0				0,80				
Energy consumed by evaporation		0	1	-3,1	kWh/Use	0,60	57	/(P*a)	0	* (1-	0	) *	0,00	/	8,76	=	**0**
Refrigerating		1	1	0,8	kWh/d	1,00	365	d/a	285	*			1,00	/	8,76	=	**33**
Freezing		1	0	0,9	kWh/d	0,90	365	d/a	289	*			1,00	/	8,76	=	**0**
or combination		0	1	1,0	kWh/d	1,00	365	d/a	0	*			1,00	/	8,76	=	**0**
Cooking		1	1	0,3	kWh/Use	1,00	500	/(P*a)	7500	*			0,50	/	8,76	=	**428**
Lighting		1	1	60,0	W	1,00	2,9	kh/(P*a)	10440	*			1,00	/	8,76	=	**1192**
Consumer Electronics		1	1	80,0	W	1,00	0,55	kh/(P*a)	2640	*			1,00	/	8,76	=	**301**
Household Appliances/Other		1	1	50,0	kWh	1,00	1,0	/(P*a)	3000	*			1,00	/	8,76	=	**342**
Auxiliary Appliances (cf. Aux Electricity Sheet)																=	**849**
Other Applications (cf. Electricity Sheet)		0	0,0						0	*			0	/	8,76	=	**0**
Persons		60	1	80,0	W/P	1,00	8,76	kh/a	42048	*			0,55	/	8,76	=	**2640**
Cold Water		60	1	-3,2	W/P	1,00	8,76	kh/a								=	**-191**
DHW - circulation		1	1	31,3	W	1,00	8,76	kh/a	274	*			1,00	/	8,76	=	**31**
DHW - individual pipes		1	1	65,5	W	1,00	8,76	kh/a	574	*			1,00	/	8,76	=	**65**
DHW - storage		1	1	133,0	W	1,00	8,76	kh/a	1165	*			1,00	/	8,76	=	**133**
Evaporation		60	1	-25,0	W/P	1,00	8,76	kh/a	-13140	*			1,00	/	8,76	=	**-1500**
Total															W		**5207**
Specific Demand															W/m²		**7,24**
Heat Available From Internal Sources											194	d/a			kWh/(m²a)		**33,7**

EnerPHit planning: **INTERNAL HEAT GAINS non-residential Use**

Building: Primary School 8 "Sveti Sveti Kiril I Metodi"

Calculation result from this worksheet

Utilisation Pattern: School — 5,43 W/m² — 4,79 W/m² — Please fill the 'Electricity non-res' worksheet carefully!

Type of Values Used: PHPP calculation ('IHG non-res' worksheet) — Manual entry: 5,43 W/m² — Wrong data entry

Calculation Internal Heat

Persons: 60,0 P — Treated floor area: 719,39 m² — Heating period: 193,97 d/a — Room Temperature: 18 °C — Internal Heat Gains Aux. Electricity: 849,2 W

Column Nr.

Persons	Select	Utilisation Pattern	Select	Activity of Persons	Planning with the number of persons or via floor area of utilisation zone (planning via area only if the occupancy is available for this utilisation pattern). Pers./Area (1 / 0)	Number of Occupants		Floor Area of Utilisation Zone (m²)	Average Occupancy (Persons / m²)	Heat emitted per person (W)	Utilisation Hours per Year [h/a]	Relative Presence	Used in Time Span (h/a)	Average Heat Emitted by Persons (W)
									27		9	18		
Persons A	10	Gymnasium	3	>10 yr., standing or light work	1 Planning with occupancy	{ 20 }*	or	{ 271 *	No standard value }*	100 *	3625 *	0,70 /	8760 =	579
Persons B	10	Gymnasium	3	>10 yr., standing or light work	1 Planning with occupancy	{ 40 }*	or	{ 280 *	No standard value }*	100 *	3625 *	0,70 /	8760 =	1159
Persons C				Invalid data input	Enter occupancy or floor area	{ }*	or	{ *	No standard value }*	0 *	0 *	1,00 /	8760 =	0
Persons D				Invalid data input	Enter occupancy or floor area	{ }*	or	{ *	No standard value }*	0 *	0 *	1,00 /	8760 =	0
Persons E				Invalid data input	Enter occupancy or floor area	{ }*	or	{ *	No standard value }*	0 *	0 *	1,00 /	8760 =	0
Persons F				Invalid data input	Enter occupancy or floor area	{ }*	or	{ *	No standard value }*	0 *	0 *	1,00 /	8760 =	0
Persons G				Invalid data input	Enter occupancy or floor area	{ }*	or	{ *	No standard value }*	0 *	0 *	1,00 /	8760 =	0
Evaporation (person specific)						60 *					3625 *	0,70 /	8760 =	0

Lighting / Equipment / Aux. Electricity	Useful Energy [kWh/a]		Availability	Used in Time Period (kh/a)	Average Heat Release
Lighting	7789	*	1,00	/ 8,76 =	889
Office Applications (Within Therm. Envelope)	0	*	1,00	/ 8,76 =	0
Cooking (Within Therm. Envelope)	0	*	0,50	/ 8,76 =	0
Dishwashing (Within Therm. Envelope)	0	*	0,30	/ 8,76 =	0
Cooling (Within Therm. Envelope)	0	*	1,00	/ 8,76 =	0
Other (Within Therm. Envelope)	0	*	1,00	/ 8,76 =	0
Auxiliary Appliances (See Aux Electricity Worksheet)					= 849

Heat loss due to cold water (calculation from column AJ)	on/off (1 / 0)	Predominant Utilisation Pattern of Building (Data transfered from Electricity non-res worksheet; input kitchen)	Number of WCs (user data)	Amount of WCs: Standard values for schools are used (X)	Number of WCs (calculation value)	DT: Cold Water Temp. - Room Temp. [K]	Occupied Days per Year [d/a]		Loss daytime [W]		Loss Nighttime [W]	Availability	Used in Period (d/a)	Average Power Cold Water
		2					8							
Cold Water Due to Flushing WC	1	31 Canteen	10	x	8	-6	250	*(	-25	+	-20	)* 1,00	/ 365 =	-31

Total	W	3445
Specific Demand	W/m²	4,8
Heat Available From Internal Sources	194 d/a	kWh/(m²a) 22

EnerPHit planning:

PRIMARY ENERGY VALUE

Building: Primary School 8 "Sveti Sveti Kiril I Metodi" - Section C

Building type: School

Treated Floor Area A_{TFA}: 719 m²

Space Heating Demand incl. Distribution: 55 kWh/(m²a)

.ns Useful cooling demand incl. dehumidification: 0 kWh/(m²a)

			Final Energy kWh/(m²a)	Primary Energy kWh/(m²a)	Emissions CO_2-Equivalent kg/(m²a)
Electricity Demand (without Heat Pump)				PE Value	CO_2-Emissions Factor (CO_2-Equivalent)
Covered Fraction of Space Heating Demand		*(Project)*	0%	kWh/kWh	g/kWh
Covered Fraction of DHW Demand		*(Project)*	0%	2,6	680
Direct Electric Heating	$Q_{H,de}$		0,0	0,0	0,0
Hot water, direct electric (without DHW wash&dish)	$Q_{DHW,de}$	*(DHW+Distribution, SolarDHW)*	0,0	0,0	0,0
Electric Post heating DHW Wash&Dish		*(Electricity, SolarDHW)*	0,0	0,0	0,0
Electricity demand lighting/auxiliary tools/kitchen	Q_{EHH}	*(Electricity worksheet)*	10,8	28,2	7,4
Electricity Demand - Auxiliary Electricity			20,8	54,1	14,1
Total electricity demand (without heat pump)			31,6	82,2	21,5
Heat pump				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
Covered Fraction of Space Heating Demand		*(Project)*	0%	kWh/kWh	g/kWh
Covered Fraction of DHW Demand		*(Project)*	0%	2,6	680
Energy Carrier - Supplementary Heating			Electricity	2,6	680
Annual coefficient of performance of heat pump 1 (heating / heating&DHW)	SPF_{H-1}	*(HP worksheet)*			
Annual coefficient of performance of heat pump 2 (DHW)	SPF_{H-1}	*(HP worksheet)*			
Heat generation efficiency (excl. DHW wash&dish)		*(HP worksheet)*			
Heat generation efficiency (incl. DHW wash&dish)		*(HP worksheet)*			
Electricity Demand Heat Pump (without DHW Wash&Dish)	Q_{HP}	*(HP worksheet)*	0,0	0,0	0,0
Non-Electric Demand, DHW Wash&Dish			0,0	0,0	0,0
Total electricity demand heat pump		*(HP worksheet)*	0,0	0,0	0,0
Compact Heat Pump Unit				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
Covered fraction of space heating demand		*(Project)*	0%	kWh/kWh	g/kWh
Covered Fraction of DHW Demand		*(Project)*	0%	2,6	680
Energy Carrier - Supplementary Heating			Electricity	2,6	680
COP Heat Pump Heating	SPF_{H-1}	*(Compact worksheet)*	0,0		
COP Heat Pump DHW	SPF_{H-1}	*(Compact worksheet)*	0,0		
Heat generation efficiency (excl. DHW wash&dish)		*(Compact worksheet)*			
Heat generation efficiency (incl. DHW wash&dish)		*(Compact worksheet)*			
Electricity Demand Heat Pump (without DHW Wash&Dish)	Q_{HP}	*(Compact worksheet)*	0,0	0,0	0,0
Non-Electric Demand, DHW Wash&Dish			0,0	0,0	0,0
Total Compact Unit		*(Compact worksheet)*	0,0	0,0	0,0
Boiler				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
Covered fraction of space heating demand		*(Project)*	100%	kWh/kWh	g/kWh
Covered Fraction of DHW Demand		*(Project)*	100%	1,1	250
Boiler Type		*(Boiler worksheet)*	Low Temperature Boi-ler Gas		
Performance Ratio of Heat Generator		*(Boiler worksheet)*	111%		
Annual Energy Demand (without DHW Wash&Dish)		*(Boiler worksheet)*	81,1	89,2	20,3
Non-Electric Demand, DHW Wash&Dish		*(Electricity worksheet)*	0,0	0,0	0,0
Total heating oil/gas/wood			81,1	89,2	20,3
District Heat				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
Covered fraction of space heating demand		*(Project)*	0%	kWh/kWh	g/kWh
Covered Fraction of DHW Demand		*(Project)*	0%		0
Heat source		*(District heating worksheet)*			
Performance Ratio of Heat Generator		*(District heating worksheet)*	0%		
Heating Demand District Heat (without DHW Wash&Dish)		*(District heating worksheet)*	0,0	0,0	0,0
Non-Electric Demand, DHW Wash&Dish		*(Electricity worksheet)*	0,0	0,0	0,0
Total district heat			0,0	0,0	0,0
Other				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
Covered fraction of space heating demand		*(Project)*	0%	kWh/kWh	g/kWh
Covered Fraction of DHW Demand		*(Project)*	0%	0,2	55
Heat source		*(Project)*	Wood		
Performance Ratio of Heat Generator		*(Project)*	0%		
Annual Energy Demand, Space Heating			0,0	0,0	0,0
Annual Energy Demand, DHW (without DHW Wash&Dish)			0,0	0,0	0,0
Non-Electric Demand, DHW Wash&Dish		*(Electricity worksheet)*	0,0	0,0	0,0
Non-Electric Demand Cooking/Drying (Gas)		*(Electricity worksheet)*	0,0	0,0	0,0
Total - Other			0,0	0,0	0,0
Cooling with Electric Heat Pump				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
				kWh/kWh	g/kWh
Covered Fraction of Cooling Demand		*(Project)*	100%	2,6	680
Heat source			Electricity		
Seasonal energy efficiency ratio cooling					
Energy Demand Space Cooling			0,0	0,0	0,0
Heating, cooling, DHW, auxiliary electricity, lighting, electrical appliances			112,7	171,5	41,8
Total PE Value		171,5	kWh/(m²a)		
Total emissions CO_2-Equivalent		41,8	kg/(m²a)		(Yes/No)
Primary Energy Requirement			168	kWh/(m²a)	no
Heating, DHW, auxiliary electricity (no lighting and electrical appliances)			101,9	143,3	34,4
Specific PE Demand - Mechanical System		143,3	kWh/(m²a)		
Total emissions CO_2-Equivalent		34,4	kg/(m²a)		
Solar electricity			kWh/a	PE-Value (Generation) kWh/kWh	CO_2-Emission Factor g/kWh
Planned Annual Electricity Generation		*(Worksheet PV)*			
Specific Demand					
PE Value: conservation by solar electricity			kWh/(m²a)		
Saved CO_2 emissions through solar electricity			kg/(m²a)		

EnerPHit planning: **HEAT PUMP**

	Building:	Primary School 8 "Sveti Sveti Kiril I Metodi"	Building type:	School	
	Climate:	Велико Търнов	Treated Floor Area A_{TFA}:	719	m²

ın)	Covered fraction of space heating demand		*(PE Value worksheet)*	0%	
	Space Heat Demand + Distribution Losses	Q_H+Q_{HL}:	*(DHW+Distribution)*	39339	kWh/a
	Solar fraction for space heat	$\eta_{Solar,\ H}$	*(SolarDHW worksheet)*	0%	
	Effective Annual Heat Demand	$Q_{H,Wi}=Q_H*(1-\eta_{Solar,\ H})$		**0**	kWh/a
	Covered Fraction of DHW Demand		*(PE Value worksheet)*	0%	
	Total heat demand of DHW system	Q_{gDHW}	*(DHW+Distribution)*	12758	kWh/a
	Solar fraction for DHW	$\eta_{Solar,\ DHW}$	*(SolarDHW worksheet)*	0%	
	Effective DHW demand	$Q_{DHW,Wi}=Q_{DHW}*(1-\eta_{Solar,\ DHW})$		**0**	kWh/a
	Number of heat pumps in the system			1	
	Functionality			Heating & DHW	
Heating					
	Selection of HP: None	Heat source:			
	Selection of distribution system			Supply air heating	
	Design distribution temperature	θ_{design}	*(DHW+Distribution)*	55,00	°C
	Nomimal Power of distribution system	P_{nom}		16,00	kW
	Distribution system (fulfilled from expert users only)				
	Nominal Power of distribution system	P_{nom}		16,00	kW
	Radiator exponent	n		1,30	
	Heating storage			No	
	Specific heat losses storage	U * $A_{storage}$			W/K
	Storage location in thermal envelope	inside or outside of the thermal envelope		Inside	
	Room temperature (Storage location: outside of thermal envelope)		*(DHW+Distribution)*	4,50	°C
	Sink temperature of heat pump for heating	θ_{snk}		55,00	°C
Entries in relation to the domestic hot water system					
	Selection of HP: None	Heat source:			
	DHW temperature		*(DHW+Distribution)*	60,00	°C
	DHW storage location	inside or outside of the thermal envelope		Outside	
	Specific heat losses storage	U * $A_{storage}$		2,5	W/K
	Room temperature (Storage location: outside of thermal envelope)		*(DHW+Distribution)*	0,00	°C
	Type of backup heater			Electr. immersion heater	
	Δθ of Electric flow type heater			5,0	K
In case of one heat pump with functionality: Heating & DHW					
	Same heat pump's sink temperature for Heating and for DHW			No	
	Heat Pump Priority		*(Manufacturer, Techn. Data)*	DHW priority	
Control					
	Control strategy			On / off	
Heating					
	Depth (horizontal / vertical) ground heat exchanger	z		50,0	m
	Power of pump for ground heat exchanger	P_{pump}		0,05	kW

EnerPHit planning: **H E A T P U M P**

0

Heating

Heat pump:
Source:

	θ_source °C	θ_sink °C	Heating capacity kW	COP
Test Point 1				
Test Point 2				
Test Point 3				
Test Point 4				
Test Point 5				
Test Point 6				
Test Point 7				
Test Point 8				
Test Point 9				
Test Point 10				
Test Point 11				
Test Point 12				
Test Point 13				
Test Point 14				
Test Point 15				

Temperature difference in sink $\Delta\theta_{Sink}$ K

DHW

Heat pump:
Source:

	θ_source °C	θ_sink °C	Heating capacity kW	COP
Test Point 1				
Test Point 2				
Test Point 3				
Test Point 4				
Test Point 5				
Test Point 6				
Test Point 7				
Test Point 8				
Test Point 9				
Test Point 10				
Test Point 11				
Test Point 12				
Test Point 13				
Test Point 14				
Test Point 15				

Temperature difference in sink $\Delta\theta_{Sink}$ K

Electrical energy consumption of pump (groundwater / groun	Q_{pump}	0	kWh/a
Energy by Direct Electricity	$Q_{E,dir}$	0	kWh/a
Space heat supplied by HP	$Q_{HP,Heating}$	0	kWh/a
Winter DHW supplied by HP	$Q_{HP,DHW,Winter}$	0	kWh/a
Summer DHW supplied by HP	$Q_{HP,DHW,Summer}$	0	kWh/a
Space heating supplied by HP without storage losses	$Q_{HP,Heating}$	0	kWh/a
Winter DHW supplied by HP without storage losses	$Q_{HP,DHW,Winter}$	0	kWh/a
Summer DHW supplied by HP without storage losses	$Q_{HP,DHW,Summer}$	0	kWh/a
Electrical consumption of HP	Qel_{HP}		kWh/a

		1. HP: Heating or heating & DHW	2. HP: Domestic hot water
Seasonal performance factor of Heat Pump	SPF_{H-1}		
Seasonal Performance factor of System	SPF_{H-3}		
Heat generation efficiency DHW & heating			
		kWh/a	kWh/(m²a)
Final electrical energy demand heat generation	Q_{final}		
Annual primary energy demand			
		kg/a	kg/(m²a)
Annual CO_2-Equivalent Emissions			

EnerPHit planning:

HP Ground (Ground probes / Ground collectors)

Building: Primary School 8 "Sveti Sveti Kiril I Metodi" - Section C Building type: School

Climate: Велико Търнов Treated Floor Area A_{TFA}: 719 m²

Ground probes

Probe field configuration		A	Individual probe	
Length of probe	*(HP worksheet)*	H	50	m
Probes spacing/distance		B		m
Depth (z=H/2)		z	25	m
Type of probe		A	Double-U	
Borehole radius		R_b		m
Inner radius of pipe		R_i		m
Exterior pipe radius		R_a		m
Distance between pipes		BU		m
Inner radius of pipe casing (only coaxial)		R_{i2}		m
Exterior radius casing pipe (only coaxial)		R_{a2}		m
Thermal conductivity of pipe		λ_R		W/(mK)
Thermal conductivity of back fill		λ_F		W/(mK)
Probe time constant		t_p	#DIV/0!	d
Internal borehole resistance		R_a		Km/W
Borehole resistance		R_b		Km/W

Ground

Soil type	J	0	
Density of the ground	ρ_E	0	kg/m³
Thermal capacity of ground	cp_E	0	J/(kgK)
Thermal conductivity of ground	λ_E	0,0	W/(mK)
Soil temperature conductivity	a_E	#DIV/0!	m/s²
Ground temperature gradient	ΔT_G	0,022	K/m

Brine

Brine (characteristics at 2 °C)	E	0	
Density of the brine	ρ_S	0	kg/m³
dynamic viscosity of the brine	η_S	0	kg/(ms)
Heat capacity brine	cp_S	0	J/(kgK)
Thermal conductivity of brine	λ_S	0	W/(mK)
Brine - mass flow	m_S		kg/s

Operation type

Waste heat of active cooling to ground probe? Please check, if applicable.

Heat pump operation duration			h/a
Specific heat extraction rate as an annual average	q_{ex}		W/m
	H/R_b		W/K

Ground collectors

Inner radius of pipe	r_i	0,013	m
Exterior pipe radius	r_a	0,016	m
Thermal conductivity of pipe	λ_r	0,420	W/(mK)
Pipe depth	z_{pipe}	50	m
Ground water depth	z_{gw}		m
Pipe spacing	D	0,4	m
Base area		80	m²
Pipe outer surface		20,1	m²
Pipe length	L	200,0	m

Brine

Brine (characteristics at 2 °C)	E	0	
Density of the brine	ρ_S	0	kg/m³
dynamic viscosity of the brine	η_S	0	kg/(ms)
Heat capacity brine	cp_S	0	J/(kgK)
Thermal conductivity of brine	λ_S	0	W/(mK)
Brine - mass flow	m_S	0,5	kg/s
Specific heat extraction rate	q_{ex}		W/m²
U * A			W/K

Climate

Period duration		365	d
Average ground surface temperature	T_{m0}	11,4	°C
Surface temperature amplitude	T1	11,4	°C
Phase shifting surface	t_{02}	31	d

EnerPHit planning:

HP Ground (Ground probes / Ground collectors)

Ground characteristics		Thermal conductivity [W/(mK)]	Density [kg/m³]	Heat capacity [J/(kg K)]	Heat capacity [MJ/(m³ K)]	Temperature conductivity [10-7 m²/s]	Source
A	Sand, 9% moisture	0,980	1440	1507	2,170	4,520	[Neiß 1977]
B	Sand, 13% moisture	1,500	1600	1800	2,880	5,210	[Neiß 1977]
C	Ground, coarse gravel	0,520	2000	1840	3,680	1,410	[VDI 1984]
D	Loam, 36% moisture	2,300	1650	2847	4,700	4,900	[Neiß 1977]
E	Clay	1,280	1500	880	1,320	9,700	[VDI 1984]
F	Clay / Silt	2,200	2550	882	2,250	9,780	[VDI 2000]
G	Slate	2,100	2700	870	2,350	8,940	[VDI 2000]
H	Silt	1,500	1920	2938	5,640	2,660	[ISO 13370]
I	Rock	3,500	2500	2500	6,250	5,600	[ISO 13370]
J							

Properties of the brine		Temperature [°C]	Density [kg/m³]	Heat capacity [J/(kg K)]	Thermal conductivity [W/(mK)]	Dynamic viscosity [kg/(ms)]
A	Ethylene glycol 25%	2	1052	3950	0,480	0,0052
B	Potassium carbonate	2	1265	2941	0,544	0,0031
C	Potassium formate	2	1226	3190	0,534	0,00237
D	Water	2	997	4190	0,590	0,001307
E						

Result ground probe calculation

Month	Borehole Temperature °C
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

EnerPHit planning: **COMPACT UNIT WITH EXHAUST AIR HEAT PUMP**

Calculation based on measured values of the laboratory evaluation for component certification

Building: primary School 8 "Sveti Sveti Kiril I Metodi" - Se | Building type: School

Treated Floor Area A_{TFA}: 719 m²

				incl. DHW Connection for Washing Machines & Dishwashers	
Covered fraction of space heating demand	*(PE Value worksheet)*	0%			
Space Heating Demand + Distribution Losses	Q_H+Q_{HL} *(DHW+Distribution)*	39339	kWh		
Solar contribution for space heaing	$\eta_{Solar,\ H}$ *(SolarDHW worksheet)*	0%			
Effective Annual heating demand	$Q_{H,WI}=Q_H*(1-\eta_{Solar,\ H})$	0	kWh		
Covered Fraction of DHW Demand	*(PE Value worksheet)*	0%			
Total Heating Demand of DHW system	Q_{gDHW} *(DHW+Distribution)*	13329	kWh	13329	kWh
Solar contribution for DHW	$\eta_{Solar,\ DHW}$ *(SolarDHW worksheet)*	0%		0%	
Effective DHW Demand	$Q_{DHW,WI}=Q_{DHW}*(1-\eta_{Solar,\ DHW})$	0	kWh	0	kWh

Sort: AS LIST

Compact unit selection: Go to list of compact units

Measured Values from Laboratory Test Invalid selection: for the time being compact HP units or combined HPs can ONLY be considered as single units, meaning they can ONLY be calculated with the 'Ventilation' worksheet (please check the

Ventilation

Effective heat recovery efficiency	η_{eff} *(Test stand)*		
Electric Efficiency	*(Test stand)*		Wh/m³

Heating

		Test point 1	Test point 2	Test point 3	Test point 4	
Ambient Air Temperature	T_{amb}					°C
Measured Thermal Power Heat Pump Heating	$P_{HP,Heating}$					kW
Measured COP Heating	$COP_{Heating}$					-

Domestic Hot Water

		Test point 1	Test point 2	Test point 3	Test point 4	
Ambient Air Temperature	T_{amb}					°C
Measured Thermal Power DHW Storage Heating-Up	$P_{DHW,Heating-Up}$					kW
Measured Thermal Power DHW Storage Reload	$P_{DHW,Reload}$					kW
Measured COP DHW Storage Heating-Up	$COP_{DHW,Heating-Up}$					-
Measured COP DHW Storage Reload	$COP_{DHW,Reload}$					-

Standby (Inputs required only if different from storage reload)

		Test point 1	Test point 2	Test point 3	Test point 4	
Ambient Air Temperature	T_{amb}					°C
Measured Thermal Power Heat Pump Standby	$P_{HP,Standby}$					kW
Measured COP Standby	$COP_{Standby}$					-

0%

Specific heat loss storage incl. connections	$U * A_{Storage}$ *(Test stand)*		W/K	
Average Storage Temperature in Standby Mode	$T_{DHW,Standby}$ *(Test stand)*		°C	
Heat pump priority	separate heat pumps	DHW Priority		Heating priority
	Room temperature (°C)	18		
	Av. Ambient Temp. Heating P. (°C)	5		
	Av. Ground Temp (°C)	11		
Efficiency SHX Exhaust Air Mixing	η^*_{SHX}			
Heat Recovery Efficiency SHX Exhaust Air Mixing (if applicable)	$\eta_{SHX,add}$ *(Design Value)*	0%		
Volume Flow Rate of Added Exhaust Air (if applicable)	V_{add} *(Test stand)*		m³/h	
Hydraulic frost protection				

Heat supplied by direct electricity	$Q_{E,dir}$		kWh/a		kWh/a
Space heat supplied by HP	$Q_{HP,Heating}$		kWh/a		kWh/a
Winter DHW supplied by HP	$Q_{HP,DHW,Winter}$	0	kWh/a	0	kWh/a
Winter standby heat supplied by HP	$Q_{HP,Standby,Winter}$		kWh/a		kWh/a
Summer DHW supplied by HP	$Q_{HP,DHW,Summer}$	0	kWh/a	0	kWh/a
Summer standby heat supplied by HP	$Q_{HP,Standby,Summer}$		kWh/a		kWh/a

Performance Ratio of Heat Generator, DHW & Space Heating					
Annual Coefficient of Performance	SPF_{H-3}				
		kWh/a	kWh/(m²a)	kWh/a	kWh/(m²a)
Final energy demand heat generation	Q_{final}				
Annual primary energy demand					
		kg/a	kg/(m²a)	kg/a	kg/(m²a)
Annual CO_2-Equivalent Emissions					

EFFICIENCY OF HEAT GENERATION (gas, oil & wood)

Building: Primary School 8 "Sveti Sveti Kiril I Metodi" - Sectic Building type: School

Treated Floor Area A_{TFA}: 719 m²

Covered fraction of space heating demand	*(PE Value worksheet)*	100%	
Space Heating Demand + Distribution Losses	$Q_H+Q_{HS;}$ *(DHW+Distribution)*	39339	kWh
Solar contribution for space heaing	$\eta_{Solar,\ H}$ *(SolarDHW worksheet)*	0%	
Effective Annual heating demand	$Q_{H,Wi}=Q_H*(1-\eta_{Solar,\ H})$	**39339**	kWh
Space Heating Demand without Distribution Losses	Q_H *(Verification sheet)*	39328	kWh
Covered Fraction of DHW Demand	*(PE Value worksheet)*	100%	
Total Heating Demand of DHW system	Q_{gDHW} *(DHW+Distribution)*	13329	kWh
Solar contribution for DHW	$\eta_{Solar,\ DHW}$ *(SolarDHW worksheet)*	0%	
Effective DHW Demand	$Q_{DHW,Wi}=Q_{DHW}*(1-\eta_{Solar,\ DHW})$	**13329**	kWh

Additional selection only in the case of Natural Gas

Boiler Type	*(Project)*	Low Temperature Boi-ler Gas	
Primary Energy factor	*(Data worksheet)*	1,1	kWh/kWh
CO_2-Emissions Factor (CO_2-Equivalent)		250	g/kWh
Useful heat provided	Q_{Use}	52667	kWh/a
Max. Heating Power Required for Heating the Building	P_{BH} *(Heating load worksheet)*	31,56	kW
Length of the Heating Period	t_{HP}	4655	h
Length of DHW Heating Period	t_{DHW}	8760	h

Use characteristic values entered (check if appropriate)?

		Project Data		Standard Values		Input field	
Design Output	P_{Nom} *(Rating Plate)*	32	kW	32	kW		
Installation of Boiler (Outdoor: 0, Indoor: 1)		0		0			
Input Values (Oil and Gas Boiler)		Project Data		Standard Values		Input field	
Boiler Efficiency at 30% Load	$\eta_{30\%}$ *(Manufacturer)*	91%		91%			
Boiler Efficiency at Nominal Output	$\eta_{100\%}$ *(Manufacturer)*	91%		91%			
Standby Heat Loss Boiler at 70 °C	$q_{B,70}$ *(Manufacturer)*	1,1%		1,1%			
Average Return Temperature Measured at 30% Load	$\vartheta_{30\%}$ *(Manufacturer)*	40	°C	40			
Input Values (Biomass Heat Generator)		Project Data		Standard Values		Input field	
Efficiency of Heat Generator in Basic Cycle	η_{GZ} *(Manufacturer)*			60%			
Efficiency of Heat Generator in Constant Operation	η_{SO} *(Manufacturer)*			70%			
Average Fraction of Heat Output Released to Heating Circuit	$z_{HC,m}$ *(Manufacturer)*			0,4			
Temperature Difference Betw. Power-On and Power-Off	$\Delta\vartheta$ *(Manufacturer)*		K	30	K		
For Interior Installations: Area of Mechanical Room	$A_{install}$ *(Project)*		m²	0	m²		
Useful heat output per basic cycle	$Q_{N,GZ}$ *(Manufacturer)*		kWh	48,0	kWh		
Average Power Output of the Heat Generator	$Q_{N,m}$ *(Manufacturer)*		kW	32,0	kW		
Heat generator without pellets conveyor							
Unit with regulation (no fan / no starting aid)							
Heating energy demand for a basic machine cycle	$Q_{HE,GZ}$ *(Manufacturer)*		kWh	0,98	kWh		kWh
Power consumption in steady state operation	$P_{el,SB}$ *(Manufacturer)*		W	490	W		W

Utilisation factor heat generator heating run	$h_{H,g,K}$ $=f_\varphi*\eta_{K;}$	91%
Utilisation factor heat generator DHW run	$h_{TW,g,K}$ $=\eta_{100\%}/f_{\varphi,TW}$	88%
Utilisation factor heat generator DHW & heating	$h_{g,K}$	90%

		kWh/a	kWh/(m²a)
Final energy demand space heating	$Q_{Final,\ HE}$ $= Q_{H,wi}* e_{H,g,K}$	43181	
Final energy demand DHW	$Q_{Final,\ DHW}$ $= Q_{DHW,wi}* e_{TW,g,K}$	15166	
Total final energy demand	Q_{Final} $= Q_{Final,DHW} + Q_{Final,HE}$	58347	81,1
Annual primary energy demand		64182	89,2
		kg/a	kg/(m²a)
Annual CO_2-Equivalent Emissions		14587	20,3

Building:	Primary School 8 "Sveti Sveti Kiril I Metodi" - Se	Building type:	School	
		Treated Floor Area A_{TFA}:	719	m²
Covered fraction of space heating demand		*(PE Value worksheet)*	0%	
Annual heating demand kWh/a		Q_H *(DHW+Distribution)*	39339	kWh
Solar contribution for space heaing		$\eta_{Solar,\ H}$ *(SolarDHW worksheet)*	0%	
Effective Annual heating demand	$Q_{H,Wi}=Q_H*(1-\eta_{Solar,\ H})$		**0**	kWh
Covered Fraction of DHW Demand		*(PE Value worksheet)*	0%	
DHW Demand		Q_{DHW} *(DHW+Distribution)*	13329	kWh
Solar contribution for DHW		$\eta_{Solar,\ DHW}$ *(SolarDHW worksheet)*	0%	
Effective DHW Demand	$Q_{DHW,Wi}=Q_{DHW}*(1-\eta_{Solar,\ DHW})$		**0**	kWh
Heat source			None	
Primary Energy factor		*(Data worksheet)*		kWh/kWh
CO_2-Emissions factor (CO_2-Equivalent)		*(Data worksheet)*	0	g/kWh
Utilisation factor of heat transfer station	ha,HX			

		kWh/a	kWh/(m²a)
Final energy demand heat generation	$Q_{final} = Q_{Use} * e_{a,DH}$	**0**	**0,0**
Annual primary energy demand		**0**	**0,0**
		kg/a	kg/(m²a)
Annual CO_2-Equivalent Emissions		**0**	**0,0**

Table of Primary Energy Factors and CO_2-Equivalent Emissions Factors of Various Energy Carriers

Energy Type		Energy Carrier	PE (non-regenerative) kWh_{Prim}/kWh_{Final}	CO_2 GEMIS 3.0 kg/kWh_{Final}
	1	None		
Fuel Source	2	Oil	1,1	0,31
	3	Natural Gas	1,1	0,25
	4	LPG	1,1	0,27
	5	Hard Coal	1,1	0,44
	6	Wood	0,2	0,05
Electricity	7	Electricity-Mix	2,6	0,68
	8	Electricity from Photovoltaics	0,7	0,25
	1	None	0	0
District Heat	2	Hard Coal CGS 70% PHC	0,8	0,24
	3	Hard Coal CGS 35% PHC	1,1	0,32
	4	Hard Coal HS 0% PHC	1,5	0,41
Gas CGS	5	Gas CGS 70% PHC	0,7	-0,07
	6	Gas CGS 35% PHC	1,1	0,13
	7	Gas HS 0% PHC	1,5	0,32
Heating Oil-EL CGS	8	Oil CGS 70% PHC	0,8	0,1
	9	Oil CGS 35% PHC	1,1	0,25
	10	Oil HS 0% PHC	1,5	0,41

Data Source: DIN V 4701-10/GEMIS 4.14

Heat Generator		Selection of gas type	
Nr.	Type	Nr.	Type
1	None	1	Natural Gas
2	Improved gas condensing boi-ler	2	LPG
3	Improved oil condensing boi-ler	3	
4	Condensing boi-ler gas		
5	Condensing boi-ler oil		
6	Low Temperature Boi-ler Gas		
7	Low Temperature Boi-ler Oil		
8	Wood Log Burning (Direct and Indirect Release of Heat)		
9	Wood Pellet Burning (Direct and Indirect Release of Heat)		
10	Wood Pellet Burning (Only Indirect Release of Heat)		
11	Reserve		

Dishwashing	Washing
1	DHW Connection
2	Cold water connection

Clothes Drying		Availability Electricity	Availability Evaporation
1	Clothesline	1	1
2	Drying Closet (cold!)	1	1
3	Drying Closet (cold!) in Exhaust Air	0,9	0,9
4	Condensation Dryer	0,7	0
5	Electric Exhaust Air Dryer	1	1
6	Gas Exhaust Air Dryer	1	1

Cooking		Electric Fraction	Primärenergiefaktor	CO_2 factor
1	Electricity	100%	2,6	0,68
2	Natural Gas	0%	1,1	0,25
3	LPG	0%	1,1	0,27